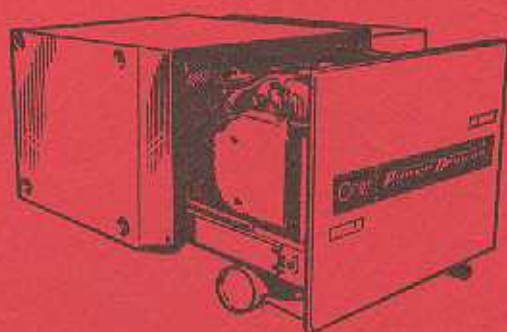




MAJOR SERVICE MANUAL

FOR

NH POWER DRAWER



**6KW ELECTRIC POWER PLANT
FOR
RECREATIONAL VEHICLES**

TABLE OF CONTENTS

General Information	2
Specifications	4
Dimensions and Clearances	5
Assembly Torques	7
Special Tools	7
Engine Troubleshooting Guide	8
Engine Disassembly	9
Oil System	21
Fuel System	23
Fuel System Troubleshooting Guide	28
Ignition and Battery Charging	30
Testing Battery Charging System	32
Starting System	33
AC Generator Maintenance	37
Generator Troubleshooting Guide	42
Controls	45
Control System Troubleshooting Guide	47
Remote Accessories	50
Plant Wiring Diagram	53

GENERAL INFORMATION

YOUR MANUAL

This manual contains information required for proper maintenance, servicing and overhaul of the 6KW Power Drawer. Study the entire manual to better understand how the plant functions. This will help in maintenance and servicing of the plant, which will result in longer life and more reliable operation.

If possible, use a parts catalog with the service manual. The parts catalog will give a good picture of assembly and disassembly and will help to identify plant components. Since the first and most important part of repair work is correct diagnosis of the trouble, troubleshooting charts are included to help find the fault.

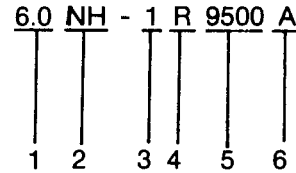
A list of special tools is included in the manual. These are available from Onan, and will make it easier to work on the plant.

When discussing left side and right side in this manual, view the plant from the engine end of the plant, which is designated the front end.

When ordering parts or requesting information always supply the complete MODEL and SPECIFICATION as shown on the Onan nameplate (see "MODEL DESIGNATION" following). This information is necessary to identify your plant among the many models manufactured by Onan.

MODEL DESIGNATION

The following typical model number is broken down into code segments used by Onan.



1. Indicates kilowatt rating.
2. Series identification.
3. Voltage code of the generator, 1 = 120 volts.
4. Method of starting: R - remote electric starting.
5. Factory code for designating optional equipment, if any.
6. Specification letter which advances when the factory makes production modifications.

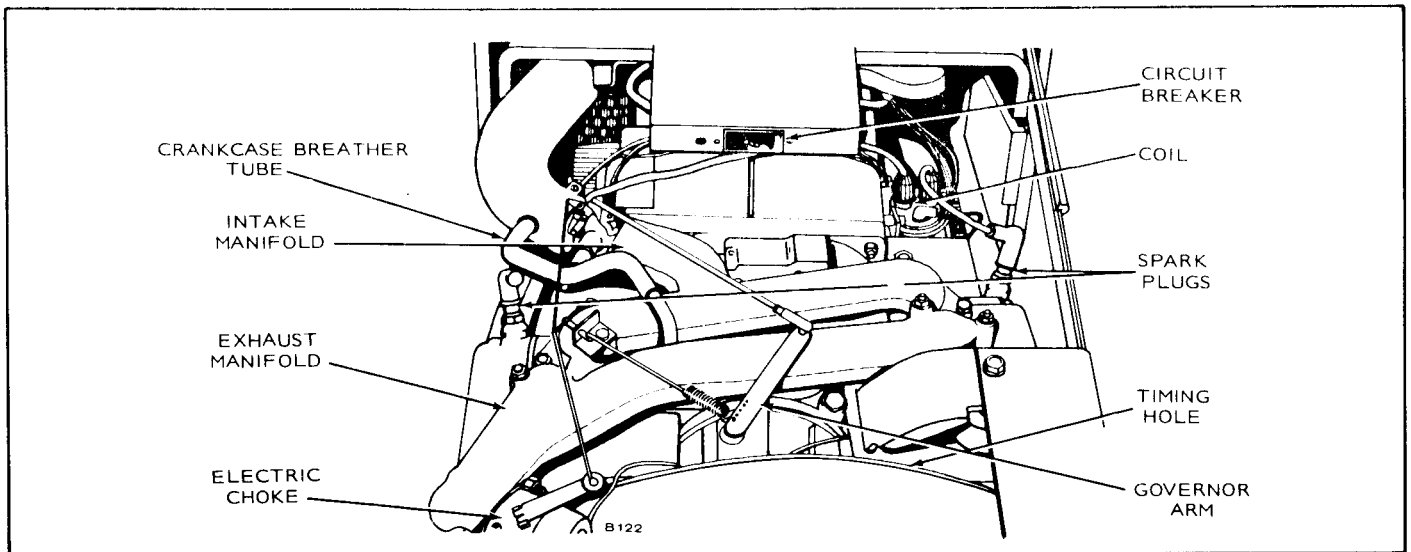
CAUTION

Onan uses this symbol throughout the text to warn of possible equipment damage.

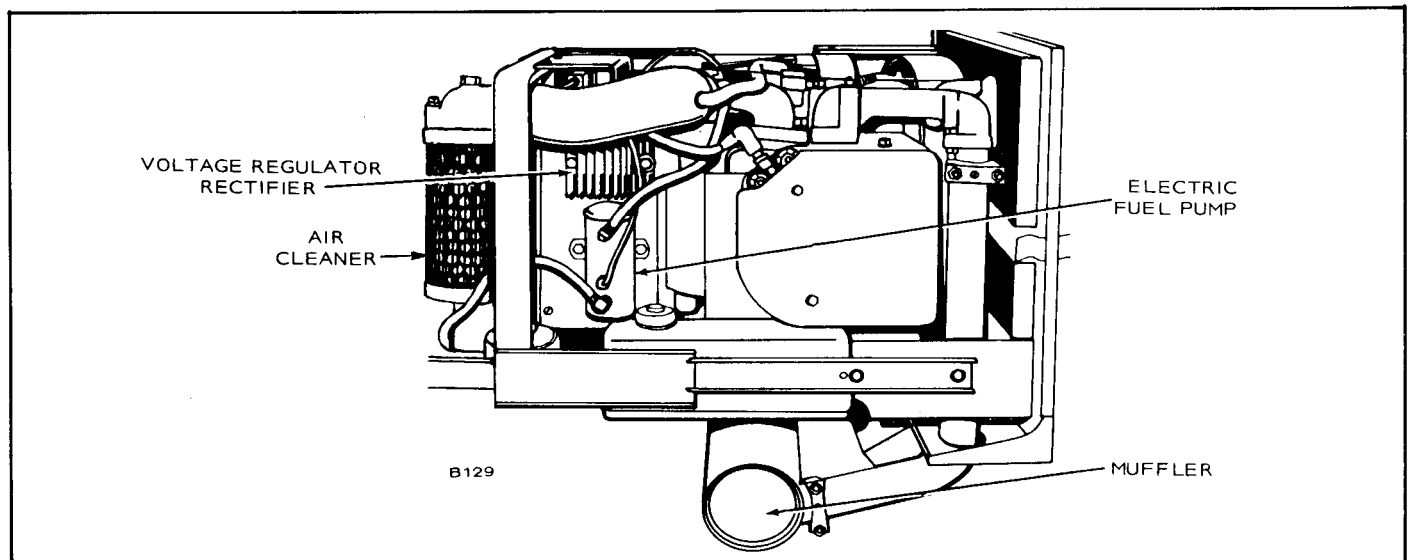
WARNING

This symbol is used to warn of any possible personal injury.

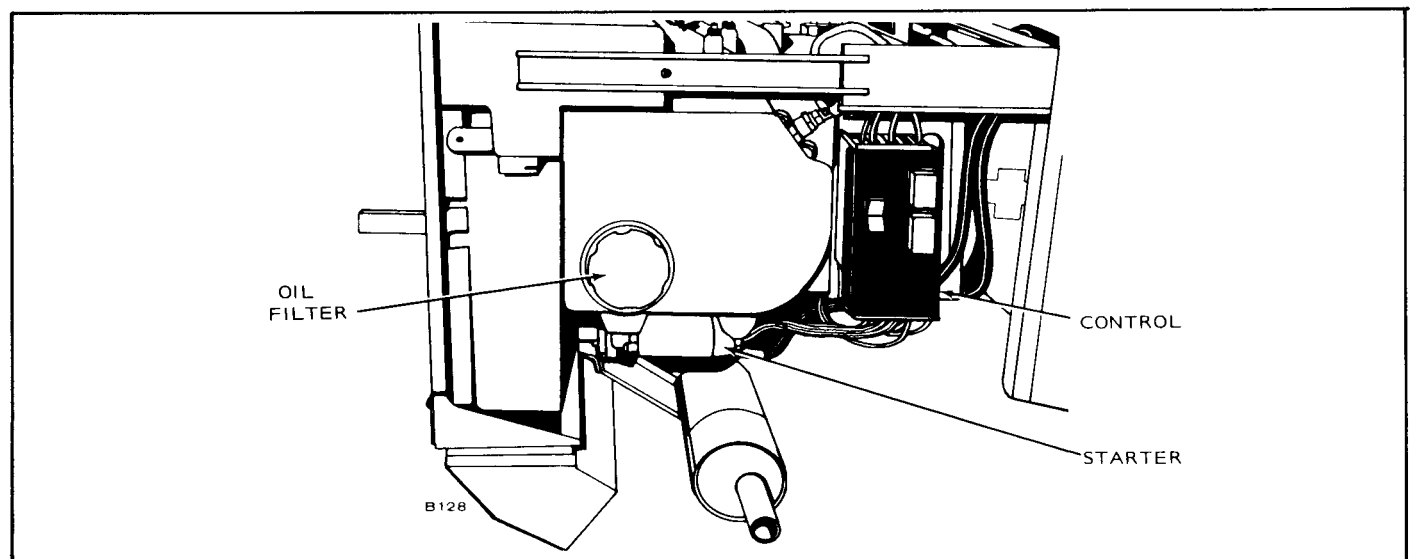
Service information contained herein applies to Model 6.0 NH-1R/9500. The basic information can also be used when servicing Model 6.0 NH-1R/9000.



TOP VIEW



LEFT SIDE



RIGHT SIDE

SPECIFICATIONS

ENGINE

Manufacturer	Onan
Design	Four Cycle, Air Cooled, L Head
Fuel	Gasoline, Regular Grade *
Fuel Pump	12 Volt, Electric
Cylinders	Two
Bore	3-9/16 inch
Stroke	3 inch
Oil Capacity	4 quarts
(With Filter Change)	4-1/2 quarts
Battery Voltage	12 Volt
Battery Size (Above 0 ° F Operation)	45 Amp/Hr Min.
Battery Charging System	10 Ampere, Flywheel Alternator
Starting System	Solenoid Shift

GENERATOR

Manufacturer	Onan
Design	Revolving Armature, Four Pole, 1800 rpm
60 Hertz Recreational Vehicle Rating	6000 Watts (6KW)
Voltage	120 Volts
Current Rating	50 Amperes
Phase	Single
Wire	Two

PROTECTION

Generator	50 or 60 Ampere Circuit Breaker
Control (Remote Wiring)	5 Ampere Fuse

TUNE-UP SPECIFICATIONS

Spark Plug Gap020 inch
Breaker Point Gap (Full Separation)020 inch
Ignition Timing (Engine Running or Static)	25 ° BTC **
Tappet Adjustment (Engine Cold)	
Intake003 inch
Exhaust012 inch

* - Onan recommends using non-leaded or low-lead regular grade gasoline.

** - Ignition timing is 25 ° BTC when point gap is set at .020. Timing can be checked with timing light through 1/2 inch diameter hole in upper rear portion of Blower Scroll. 25 ° timing is indicated when line on blower wheel is centered in 1/2 inch diameter hole.

DIMENSIONS AND CLEARANCES

All clearances given at room temperature of 70 ° F.
All dimensions in inches unless otherwise specified.

	Minimum	Maximum
Valve Tappet Clearance		
Intake	0.003	
Exhaust	0.012	
Valve Stem in Guide — Intake	0.001	0.0025
Valve Stem in Guide — Exhaust	0.0025	0.004
Valve Spring Length		
Free Length	1.662	
Compressed Length	1.375	
Valve Spring Tension (lb)		
Open	71	79
Closed	38	42
Valve Seat Bore Diameter		
Intake	1.5645	1.5655
Exhaust	1.2510	1.2520
Valve Seat Diameter		
Intake	1.569	1.570
Exhaust	1.255	1.256
Valve Stem Diameter		
Intake	0.3425	0.3430
Exhaust	0.3410	0.3415
Valve Guide Diameter (I.D.)	0.344	0.346
Valve Lifter Diameter	0.7475	0.7480
Valve Lifter Bore	0.7500	0.7515
Valve Seat Interference Width	1/32	3/64
Valve Face Angle	44 °	
Valve Seat Angle	45 °	
Valve Interference Angle	1 °	
Crankshaft Main Bearing	0.0025	0.0038
Crankshaft End Play	0.005	0.009
Camshaft Bearing	0.0015	0.003
Camshaft End Play	0.003	—
Camshaft Lift300	
Camshaft Bearing Diameter	1.3760	1.3770
Camshaft Journal Diameter	1.3740	1.3745
Rod Bearing (Forged Rod)	0.0005	0.0023
Connecting Rod End Play (Ductile Iron)	0.002	0.016
Timing Gear Backlash	0.002	0.003
Oil Pump Gear Backlash	0.002	0.005
Piston to Cylinder, Strut Type (Measured below oil-controlling ring — 90 ° from pin) Clearance	0.0015	0.0035
Piston Pin Diameter	0.7500	0.7502
Piston Pin in Piston	Thumb Push Fit	
Piston Pin in Rod	0.0001	0.0005
Piston Ring Groove Width		
Top 1	0.955	0.965
Top 2	0.0955	0.0965
Top 3	0.1880	0.1890

Spark Plug Gap020	
Crankshaft Main Bearing Journal - Standard Size	1.9992	2.000
Main Bearing Diameter	2.0015	2.0040
Main Bearing Clearance	0.0015	0.0043
Crankshaft Rod Bearing Journal - Standard Size	1.6252	1.6260
Cylinder Bore - Standard Size	3.5625	3.5635
Ignition Timing (Engine Running or Static)	25 ° BTC	

ASSEMBLY TORQUES

TORQUE SPECIFICATIONS IN LB. FT.

	MIN.	MAX.
Connecting Rod Bolts	27	29
Flywheel Mounting Screw	35	40
Oil Pump.....	7	9
Gearcase Cover	8	10
Rear Bearing Plate.....	19	21
Oil Base Mounting Screws	18	23
Cylinder Head Nuts	17	19
Intake Manifold.....	18	20
Exhaust Manifold	10	12
Oil Pan Screws (18)	8	12
Starter Mounting Bolts.....	18	20
Generator Through-Studs	15	18
Armature Hold-Down Nut (12 Point)	45	50
Spark Plugs	15	20

SPECIAL TOOLS

These tools are required when overhauling the engine. Other tools are also available from Onan. Order Tool Catalog (900-0019).

VALVE SEAT DRIVER
 VALVE GUIDE DRIVER
 OIL SEAL GUIDE AND DRIVER
 COMBINATION BEARING DRIVER (MAIN & CAM)
 COMBINATION BEARING REMOVER (MAIN & CAM)
 FLYWHEEL PULLER

ENGINE TROUBLESHOOTING GUIDE

TROUBLE	CAUSE
Backfire at Carburetor Bearing Wear Black E-Exhaust Blue Exhaust Burned Valves Connecting Rod Wear Cylinder Sticking Engine Wear Failure to Start Governor Hunting High Oil Pressure Low Oil Pressure Loss of Coolant (Water Cooled) Mechanical Knocks Mixing Overheating (Air Cooled) Overheating (Water Cooled) Piston Wear Poor Compression Ring Wear Sticking Valves	GASOLINE ENGINE TROUBLESHOOTING GUIDE
	STARTING SYSTEM
	Loose or Corroded Battery Connection
	Low or Discharged Battery
	Faulty Starter
	Faulty Start Solenoid
	IGNITION SYSTEM
	Ignition Timing Wrong
	Wrong Spark Plug Gap
	Worn Points or Improper Gap Setting
	Bad Ignition Coil or Condenser
	Faulty Spark Plug Wires
	FUEL SYSTEM
	Out of Fuel - Check
	Lean Fuel Mixture - Readjust
	Rich Fuel Mixture or Choke Stuck
	Engine Flooded
	Poor Quality Fuel
	Dirty Carburetor
	Dirty Air Cleaner
	Dirty Fuel Filter
	Defective Fuel Pump
	INTERNAL ENGINE
	Wrong Valve Clearance
	Broken Valve Spring
	Valve or Valve Seal Leaking
	Piston Rings Worn or Broken
	Wrong Bearing Clearance
	COOLING SYSTEM (AIR COOLED)
	Poor Air Circulation
	Dirty or Oily Cooling Fins
	Blown Head Gasket
	COOLING SYSTEM (WATER COOLED)
	Insufficient Coolant
	Faulty Thermostat
	Worn Water Pump or Pump Seal
	Water Passages Restricted
	Defective Gaskets
	Blown Head Gasket
	LUBRICATION SYSTEM
	Defective Oil Gauge
	Relief Valve Stuck
	Faulty Oil Pump
	Dirty Oil or Filter
	Oil Too Light or Diluted
	Oil Level Low
	Oil Too Heavy
	Dirty Crankcase Breather Valve
	THROTTLE AND GOVERNOR
	Linkage Out of Adjustment
	Linkage Worn or Disconnected
	Governor Spring Sensitivity Too Great
	Linkage Binding

ENGINE DISASSEMBLY

GENERAL

When complete engine disassembly is necessary, first remove all complete assemblies. Individual assemblies like fuel pump and carburetor can be disassembled and repaired at another time. Almost all engine maintenance, with the exception of changing main bearings or crankshaft, can be performed with unit mounted on slide rails. Removal should be seldom, if ever, necessary.

DISASSEMBLY

Common sense dictates the order of disassembly and assembly.

The suggested disassembly procedure is as follows:

1. Drain crankcase oil.
2. Disconnect exhaust pipe, fuel line, battery cables and electrical connections. Tag all electrical wires.
3. Slide unit to its full out position.
4. Install lifting eye in 3/8-16 threaded hole in intake manifold. Support unit on a suitable hoist.
5. Remove six bolts on sliding arms, three on each side. Two of the bolts on each side are located on the arms near the front supports. The third bolt on each side is located through an access hole on the arm near the rear supports.
6. Lift unit out of its slide rails and place on a suitable bench or work stand.

When removing generator and control box, tag all wires according to their respective locations.

7. Remove flywheel, using a puller or pry-bar method.
8. Remove flywheel alternator stator.
9. Remove the gear cover, being careful to protect the oil seal from keyway damage.
10. Remove the crank gear, using a gear puller and ring.
11. Remove fuel pump, oil filter, starter, carburetor, fuel lines, spark plugs, etc.
12. Remove breaker box.
13. Remove oil base, oil pump and cylinder heads.
14. Remove valves, springs, lifters, etc.
15. Remove camshaft and gear assembly.
16. Remove connecting rods, pistons and bearings.
17. Remove rear bearing plate.
18. Remove crankshaft.
19. Remove front main bearing.

Keep all parts in their respective orders. Keep valve assemblies together. Return rod caps to their respective pistons. Analyze the reasons for parts failure. See specific sections of this manual covering dimensions of parts, tolerance and wear limits, etc.

ASSEMBLY

The engine assembly procedure is normally the reverse of the disassembly procedure, observing proper clearances throughout the engine. Use a torque wrench to assure proper tightness. Coat the internal engine parts with SAE 30 oil as they are assembled. After the internal engine parts are assembled, the engine should turn over by hand freely. Use only genuine Onan parts and Onan special tools when reassembling your engine.

1. Use the proper bearing driver to install front main bearing. Front bearing kit has flanged main bearing and must be installed with Loctite provided.
2. Insert rear main bearing in rear bearing plate.
3. Install crankshaft and rear bearing plate.
4. Install connecting rods, pistons and bearings.
5. Install camshaft and gear.
6. Install valve assemblies.
7. Install oil pump, oil base and cylinder head.
8. Install breaker box.
9. Install fuel pump, oil filter, starter, generator, carburetor, fuel lines, spark plugs, etc.
10. Install crank gear, aligning crank gear mark with camshaft.
11. Install gear cover and oil seal.
12. Install flywheel alternator stator.
13. Install flywheel.
14. Install all housings, air cleaner, control box, etc.
15. Reinstall power plant in vehicle, making proper fuel, battery, electrical and exhaust connections. (Refer to wiring diagram when making electrical connections.)
16. Replace six mounting bolts.
17. Fill crankcase with oil.

OPERATIONAL CHECKOUT

1. Start engine.
2. Check oil pressure.
3. Run engine approximately 15 minutes to bring up to operating temperature.
4. Check for oil leaks, security of electrical connections, fuel lines and exhaust connections.
5. Adjust carburetor and governor linkage.
6. Check output voltage and frequency both at no load and full load conditions.

Valve locks are split, tapered type, the smaller diameter of which must face toward the valve head. Tappets are also replaceable from the valve chamber, after first removing the valve assemblies.

The valve *face* angle is 44 degrees. The valve *seat* angle is 45 degrees. This 1 degree interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life.

CAUTION

The valves should not be hand lapped, because the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used.

VALVE SYSTEM

Properly seated valves are essential to good engine performance. The aluminum cylinder heads are removable for valve servicing. Do not use a pry to loosen the cylinder head; rap sharply on the edge with a soft faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder heads, piston tops, valve ports, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve. Refer to Figure 1.

Valve faces should be finished to 44 degrees. Valve seats should be ground with a 45 degree stone and the width of the seat band should be 1/32 inch to 3/64 inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

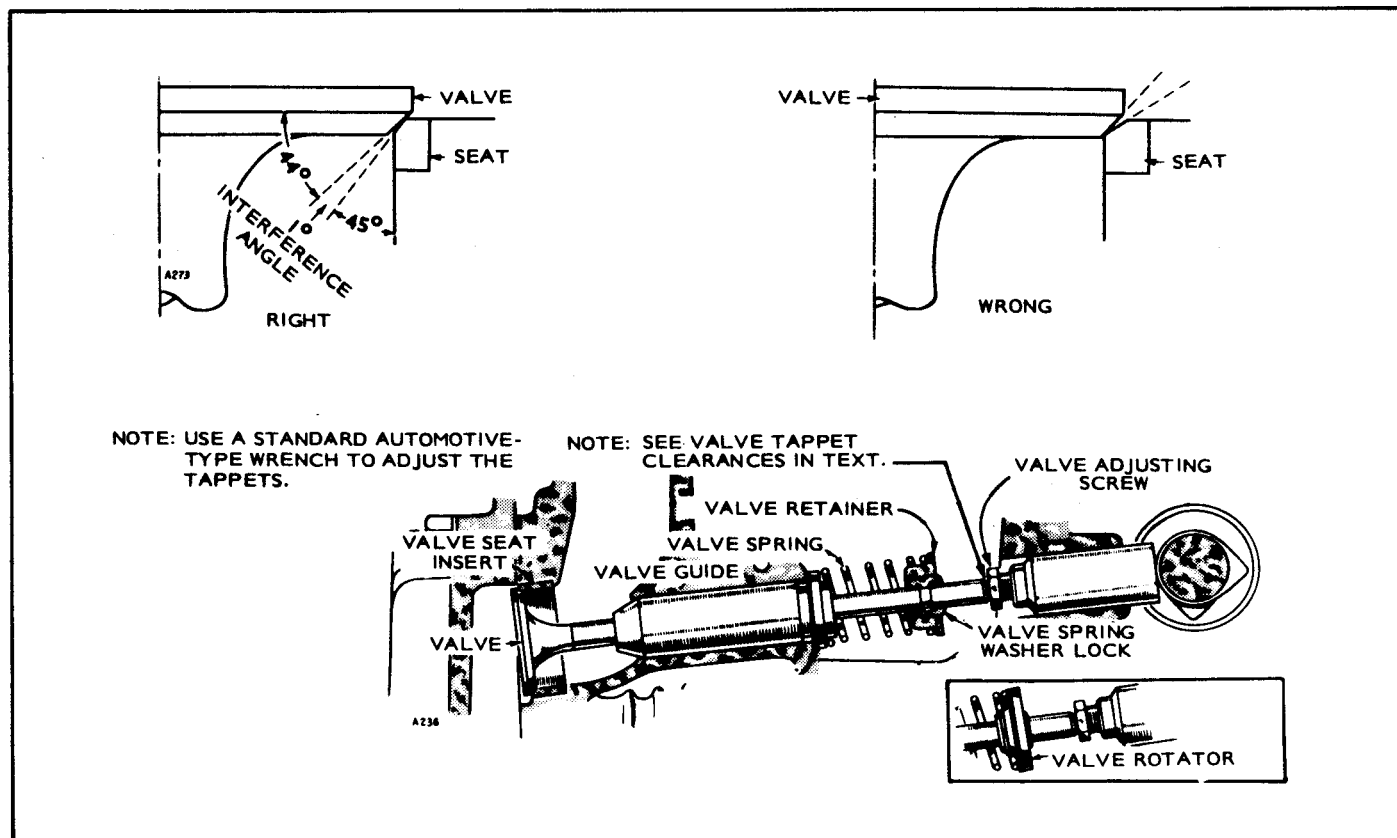


FIGURE 1. VALVE SYSTEM

Tappet Adjustment: The engine is equipped with adjustable valve tappets. The valve tappet clearance should be checked and adjusted, when necessary. Adjust the valve clearance only when engine is at ambient temperature. Proceed as follows:

1. Remove all parts necessary to gain access to valve tappets (exhaust and intake manifold and valve box cover).
2. Remove spark plugs to ease the task of turning the engine over by hand.
3. Use the engine flywheel to turn the engine over slowly by hand until the left hand intake valve opens and closes. Continue turning the flywheel until the TC mark is on the top and lined up with the TC mark on the gear cover. Both valves should be closed. This should place the left hand piston at the top of its compression stroke, the position it must be in to get proper valve adjustment for the left cylinder.
4. For the intake valve, a .003 inch thickness gauge should just pass between valve stem and tappet.
5. For the exhaust valve, a .012 inch thickness gauge should just pass between valve stem and tappet.
6. To correct the valve clearance, use a 7/16 inch open end wrench to turn the adjusting screw to obtain the correct clearance. The screw is self-locking and will stay where it is set. A 9/16 inch open end wrench is required to hold the tappet while turning the adjusting screw.
7. To adjust valves on the right hand cylinder, turn engine one complete revolution and again line up mark on the flywheel and the TC mark on the gear cover. Then follow adjustment procedure given for left hand cylinder.
8. Replace all parts removed in Step 1. Tighten all screws securely. Torque manifold bolts to specified torque.

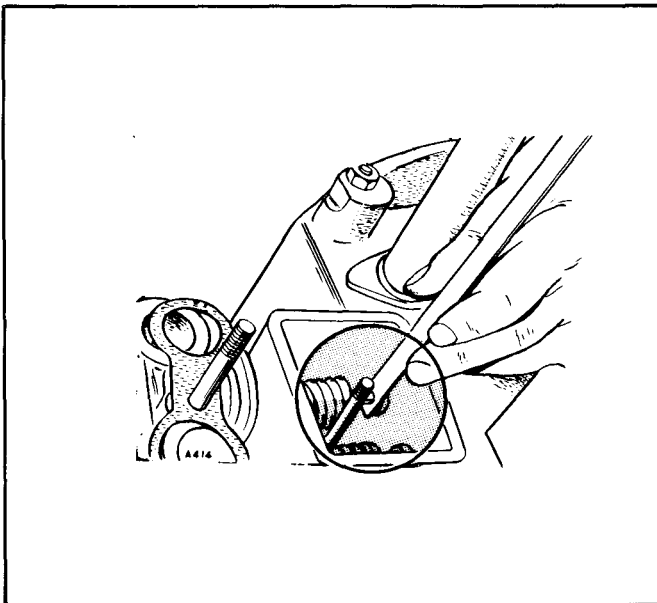


FIGURE 2. ADJUSTING VALVES

FLYWHEEL

Removing the flywheel is a relatively simple process, but the following procedure must be followed to avoid damage to the gear case and possible injury to the operator.

1. Loosen and turn the flywheel mounting screw outward about two turns.

WARNING

Do not remove the screw completely since it acts as a restrainer when the flywheel snaps loose. If the flywheel is not held by the screw, the spring action in the wheel will cause it to fly off with great force which can cause injury to the operator.

2. Install a puller bar (Onan No. 420-0100) on the flywheel as shown in Figure 3.
3. Turn the puller bar bolts in, alternately, until the wheel snaps loose on the shaft.

CAUTION

Do not use a screwdriver or similar tool or pry behind the flywheel against the gear case. The gear case cover is die-cast material and will break if undue pressure is applied in this manner.

4. Unscrew the puller from the flywheel, remove the flywheel mounting screw and washer and pull the flywheel off the shaft. Take care not to drop the wheel. A bent or broken fin will destroy the balance. Always use a steel key for mounting the flywheel.

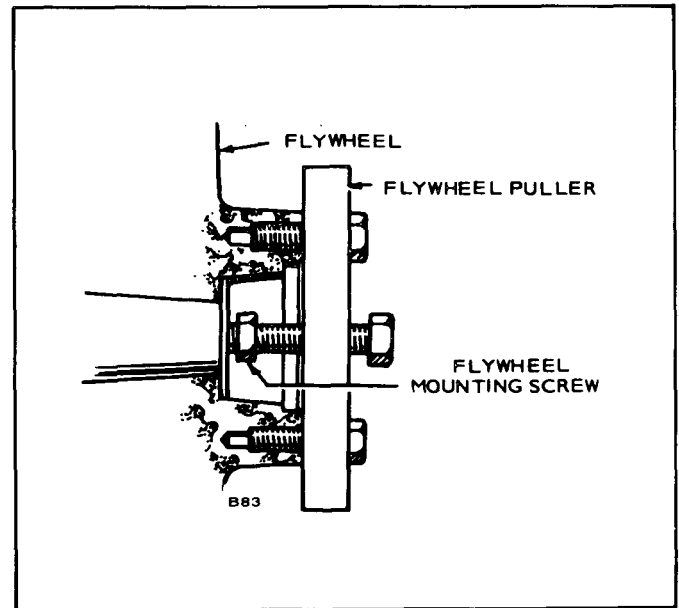


FIGURE 3. FLYWHEEL PULLER

FLYWHEEL ALTERNATOR STATOR

After disconnecting stator terminal wires, remove the three screws securing stator to gear cover and pull off.

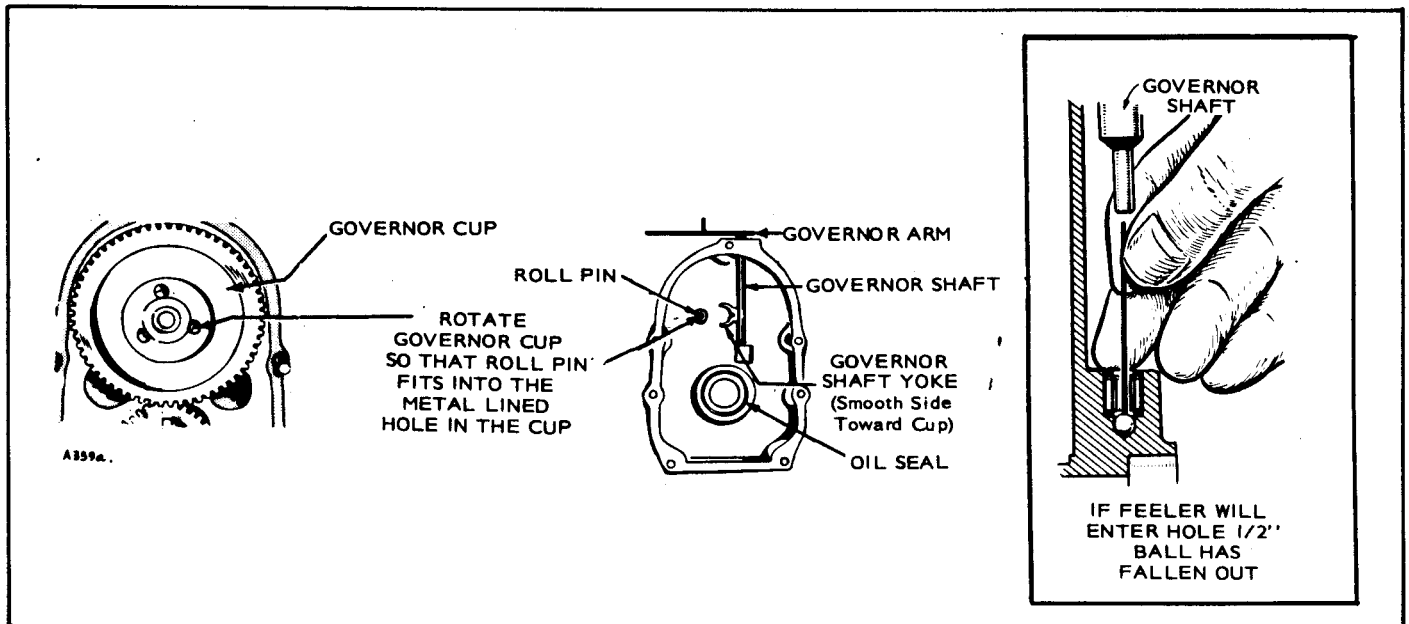


FIGURE 4. GEAR COVER ASSEMBLY

GEAR COVER

After removing the mounting screws, tap the gear cover gently with a soft faced hammer to loosen it.

When installing the gear cover, make sure that the pin in the gear cover engages the metal lined (smooth) hole in the governor cup. Turn the governor cup so that the metal lined hole is at the three o'clock position. The smooth side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal. Adjust the roll (stop) pin to protrude to a point 3/4 inch from the cover's mounting surface.

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin. Catch the flyballs while sliding the cup off.

Replace with a new part, any flyball which is grooved or has a flat spot; the ball spacer if its arms are worn or otherwise damaged; and the governor cup if the race surface is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but without any excessive play.

When installing the governor cup, tilt the engine so the gear is up, put the 10 flyballs in place (every hole). Install the cup and snap ring on the center pin.

The camshaft center pin extends out 3/4 inch from the end of the camshaft. This distance provides an in and out travel distance of 7/32 inch for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine will race especially at no load), replace camshaft. The camshaft center pin cannot be pulled outward or removed without damage. If the center pin extends out too far the cup will not hold the flyballs properly.

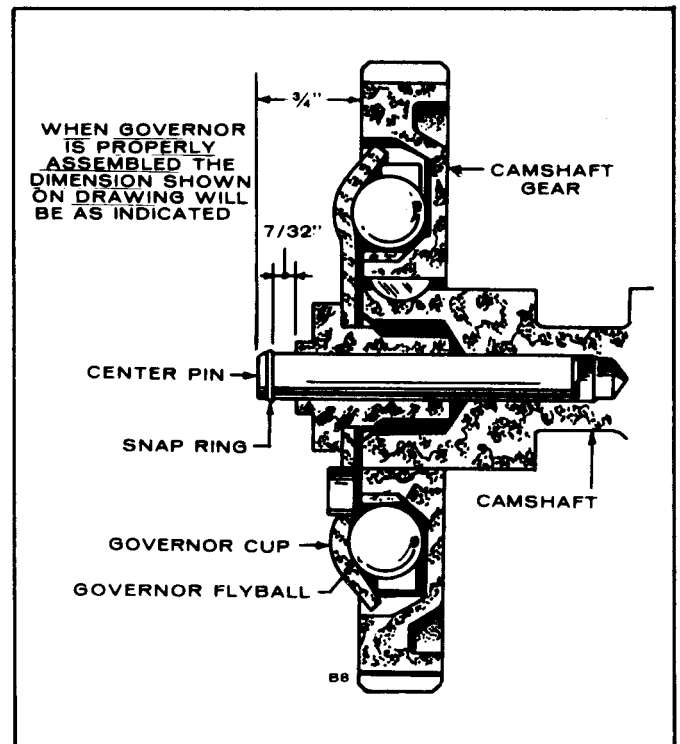


FIGURE 5. GOVERNOR CUP CROSS-SECTION

TIMING GEARS

If replacement of either the crankshaft gear or the camshaft gear becomes necessary always install both gears new.

To remove the crankshaft gear, first remove the snap ring and retainer washer, then attach the gear pulling ring (Onan Tool No. 420-0248) using two No. 10-32 screws (Figure 6). Tighten the screws alternately until both are tight. Attach a gear puller to the puller ring and proceed to remove the gear.

The camshaft and gear must be replaced as an assembly. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Then remove the operating plunger for the breaker points and tappets.

Each timing gear is stamped with "O" near the edge. The gear teeth must mesh so that these marks exactly align when the gears are installed in the engine. When installing the camshaft gear and shaft assembly, be sure that the thrust washer is properly in place behind the camshaft gear. Then install the crankshaft retaining washer and lock ring.

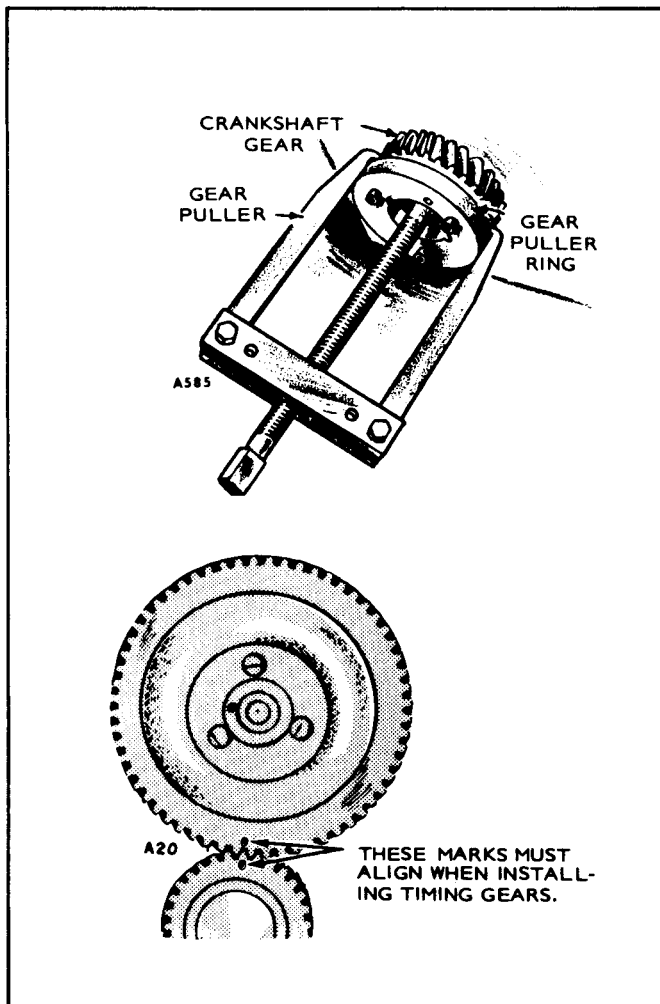


FIGURE 6. TIMING GEAR REMOVAL AND INSTALLATION

PISTONS AND CONNECTING RODS

Removal: Observe the following procedure when removing pistons and connecting rods from the engine.

1. Drain oil.
2. Remove the cylinder heads and oil base pan from the engine.
3. Remove the ridge from the top of each cylinder with a ridge reamer (if necessary) before attempting piston removal (Figure 7). Forcing the piston from the cylinder before reaming may cause damage to the piston lands.
4. Turn the crankshaft until the piston is at the bottom of its stroke and remove the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out through the top of the cylinder using a hammer handle. Avoid scratching the crankpin and cylinder wall when removing the piston and rod.

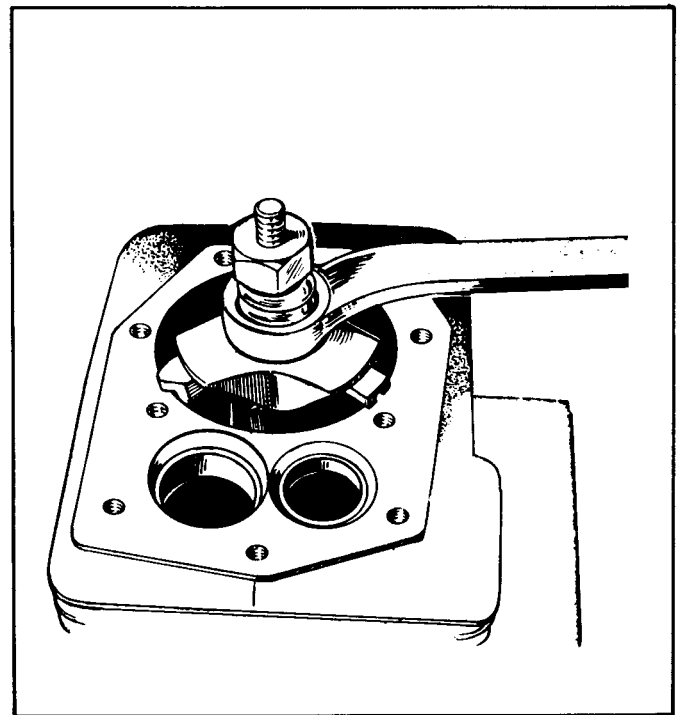


FIGURE 7. REMOVING RIDGE FROM THE CYLINDER

Mark each piston and rod assembly so they can be returned to their respective cylinders after overhaul. Keep connecting rod bearing caps with their respective rods.

5. Remove the piston rings from the piston with a piston ring spreader as shown in Figure 8. Remove the piston pin retainer and push the piston pin out.

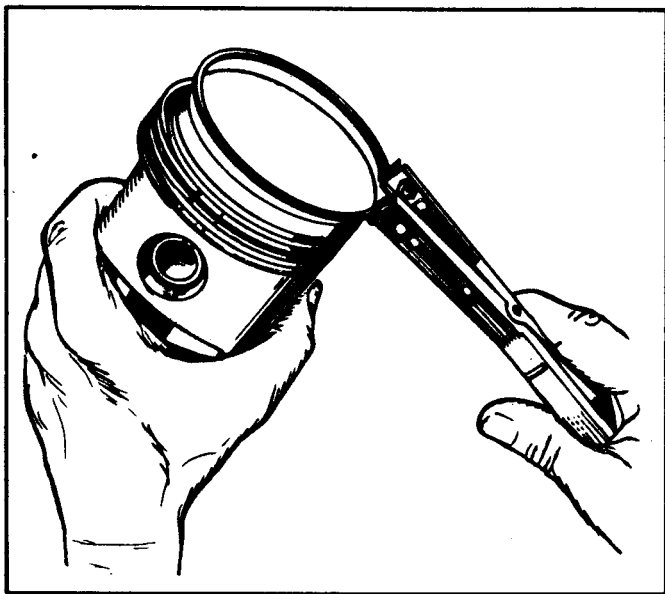


FIGURE 8. REMOVING PISTON RINGS

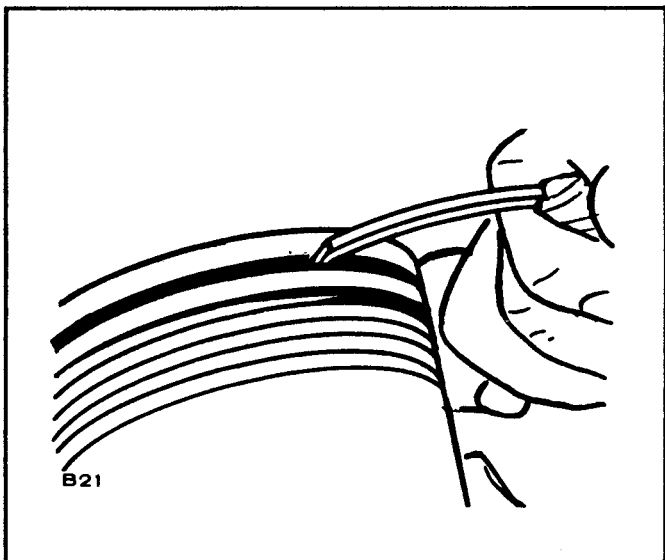


FIGURE 9. PISTON RING GROOVE CLEANING

Cleaning: Remove dirt and deposits from the piston surfaces with an approved cleaning solvent. Clean the piston ring grooves with a groove cleaner or the end of a piston ring filed to a sharp point (Figure 9). Care must be taken not to remove metal from the groove sides.

Do not use a caustic cleaning solvent or wire brush for cleaning pistons.

When cleaning the connecting rods in solvent, include the rod bore. Blow out all passages with compressed air.

Inspection: The following text contains inspection procedures concerning pistons and connecting rods.

1. Piston Inspection:

- a. Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring lands using a new ring and feeler gauge as shown in Figure 10. Replace the piston when the side clearance of the top compression ring reaches 0.008 inch.
- b. Replace pistons showing signs of scuffing, scoring, worn ring lands, fractures or damage from preignition. Excessive piston wear near the edge of the top ring land indicates preignition.

2. Connecting Rod Inspection:

- a. Replace connecting rod bolts or nuts with damaged threads. Replace connecting rods with deep nicks, signs of fractures, scored bores or bores out of round more than 0.002 inch.
- b. Use a new piston pin to check connecting rod for wear. A push fit clearance is required and varies from engine to engine. If a new piston pin falls through a dry rod pin bore as a result of its own weight, replace the rod.

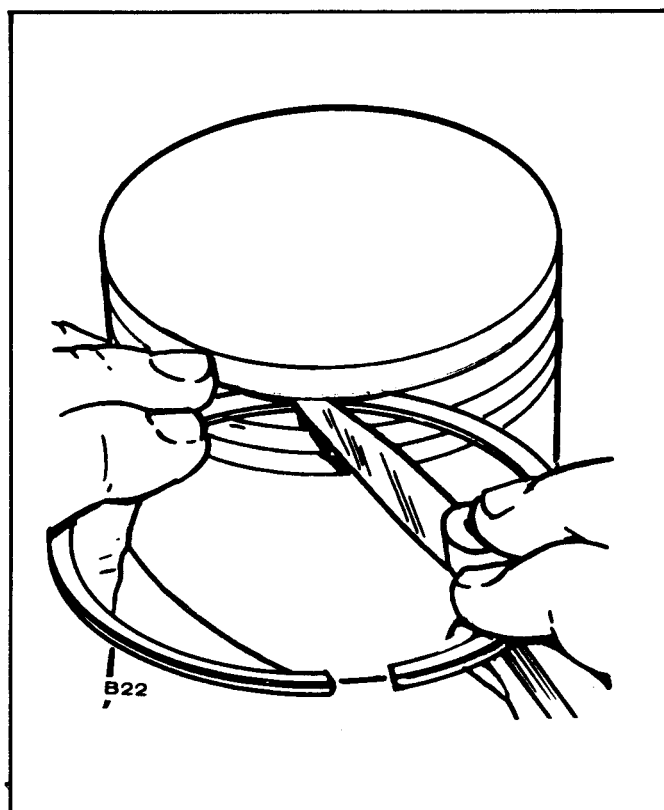


FIGURE 10. CHECKING RING SIDE CLEARANCE

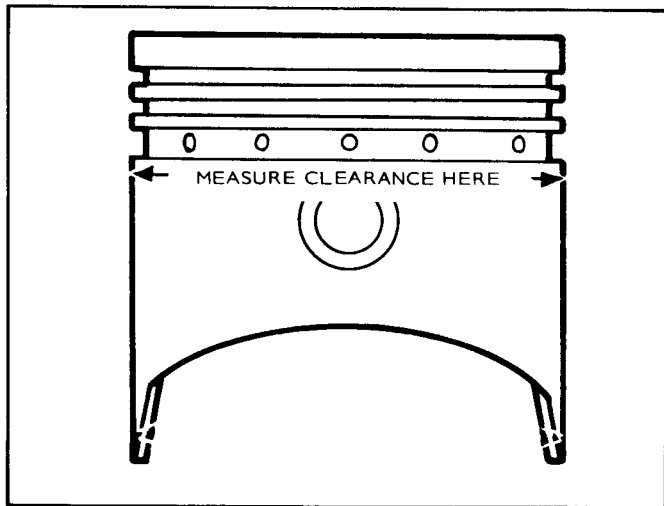


FIGURE 11. POSITIONS FOR MEASURING DIAMETERS OF PISTONS

REPAIR:

1. Fitting Pistons:

- Proper piston tolerances must be maintained for satisfactory operation.
- Measure the piston as shown in Figure 11 to be sure the total piston-to-cylinder clearance follows specifications.

2. Fitting Piston Rings:

- Install the piston ring in the cylinder bore. Invert the piston and push the ring to the end of ring travel, about halfway into the bore, which trues the ring end gap. Check the gap with a feeler gauge as shown in Figure 12.
- The practice of filing ring ends to increase the end gap is not recommended. If the ring end gap does not meet specifications, check for the correct set of rings and the correct bore size. A cylinder bore that is 0.001 inch under size will reduce the end gap 0.003 inch.

CYLINDER BLOCK

Inspection:

- Make a thorough check for cracks. Minute cracks may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide (white lead) dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.
- Inspect the cylinder bore for scoring. Check the Welsh plugs for a tight, even fit and the fins for breakage.

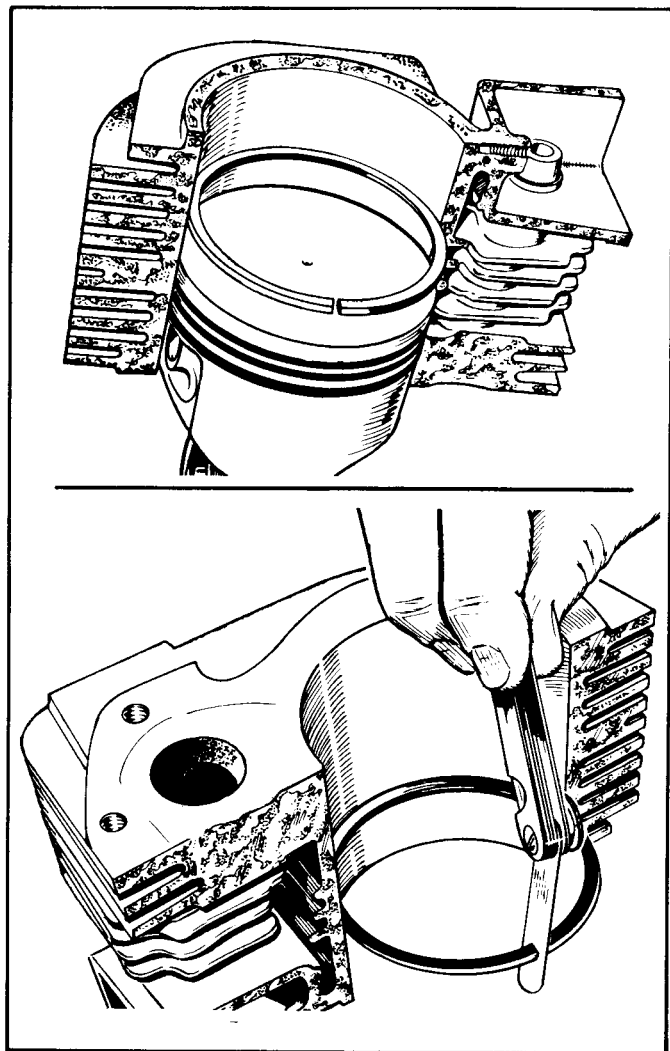


FIGURE 12. CHECKING RING END GAP

- Check the cylinder bore for taper, out of round and wear, with a cylinder bore gauge, telescope gauge or inside micrometer (Figure 13). These measurements should be taken at four places – the top and bottom of piston ring travel.
- Record measurements taken lengthwise at the top and bottom of the piston travel as follows:
 - Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where greatest ring wear occurs.
 - Also, lengthwise of the block, measure and record as "B" the cylinder diameter at the piston skirt travel.
 - Crosswise of the block, measure and record as "C" the diameter of the top of the cylinder at the greatest point of wear.

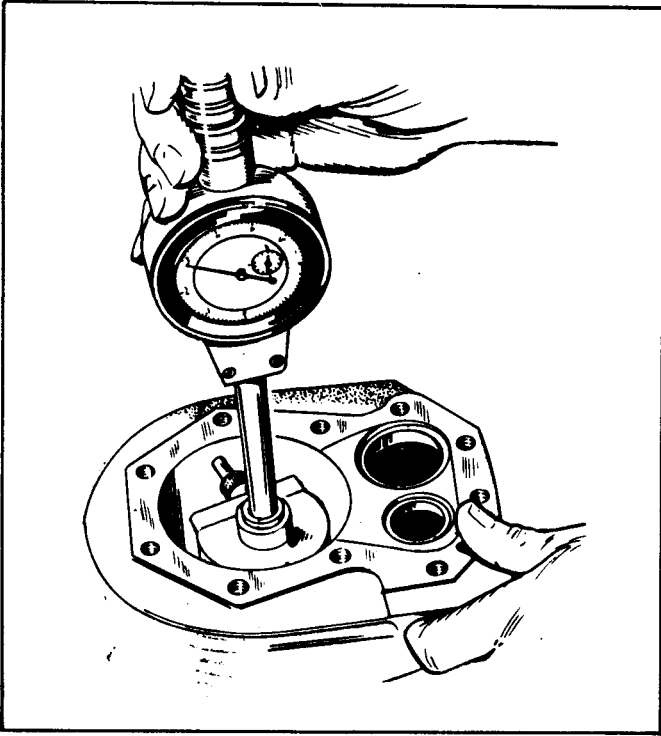


FIGURE 13. METHODS OF MEASURING THE DIAMETER OF A CYLINDER

3. Connect drill to hone and start drill. Move the hone up and down in the cylinder approximately 40 cycles per minute. Usually the bottom of the cylinder must be worked out first because it is smaller. Then when the cylinder takes a uniform diameter, move the hone up and down all the way through the bore. Follow the hone manufacturer's recommendations for wet or dry honing and oiling the hone.
4. Check the diameter of the cylinder regularly during honing. A dial bore gauge is the easiest method but a telescoping gauge can be used. Check the size at six places in the bore: measure twice at the top, middle and bottom at 90 degree angles.
5. The crosshatch formed by the scratching of the stones should form an angle of 23 degrees. This can be achieved by moving the hone up and down in the cylinder about 40 cycles per minute.

A cylinder wall micro finishing brush produces an ideal cylinder wall finish to help rings seat faster. It also is used for deglazing cylinder walls and provides a good crosshatch pattern. See Figure 14.

6. Clean the cylinder block thoroughly with soap, water and clean rags. A clean white rag should not be soiled on the wall after cleaning is complete. Do not use a solvent or gasoline since they wash the oil from the walls but leave the metal particles.
7. Dry the crankcase and coat it with oil.

- d. Measure and record as "D" the diameter at the bottom of the cylinder bore and crosswise of the block.
- e. Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper.
- f. If cylinder taper exceeds 0.005 inch, rebore and hone to accommodate the next oversize piston. Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.002 inch, the cylinders must be rebored and honed for the next oversize piston. A reboring machine is used when going to oversize pistons. The following repair data covers honing to oversize by use of a hone.

Repair:

1. A hone can be used to refinish a cylinder.
2. Anchor the block solidly for either vertical or horizontal honing. Use either a drill press or heavy-duty drill which operates at approximately 250 to 450 rpm.

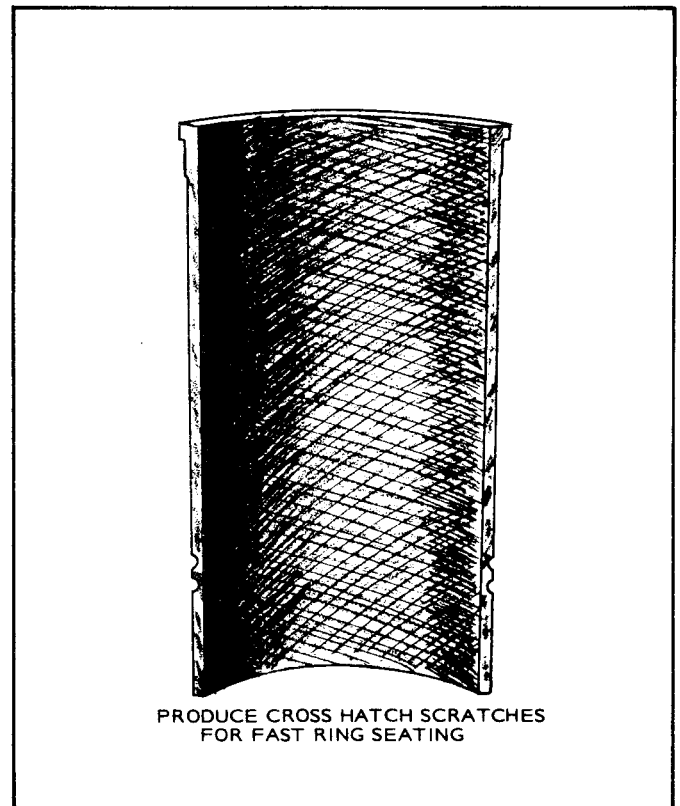


FIGURE 14. CYLINDER WALL FINISHING

CRANKSHAFT

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, replace the crankshaft.

Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

BEARINGS (Figures 15-17)

Removal: Removing camshaft or crankshaft bearings requires complete disassembly of the engine. Use a press or a suitable drive plug to remove the bearings. Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation. Use oil on the bearings to reduce friction when installing and again lubricate with oil after installing.

Replacement: Crankshaft main bearings are precision type which do not require line reaming or line boring after installation. They are available in standard size and .002 inch undersize. Expand the bearing bore by placing the casting in hot water or in an oven heated to 200°F.

CAUTION

If a torch is used, apply only a little heat.

To ease assembly, cool the precision bearing to shrink it. Align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open. Lubricate bearings with SAE20 oil before installing. The cold oiled precision bearing should require only light taps to position it with a driving tool. If head of lock pin is damaged, use side cutters or Easy Out tool to remove and install new pin. Apply oil to thrust washer (one used with each bearing) to hold it in place while installing the crankshaft. Oil grooves in thrust washers must face the crankshaft and washers must be flat (not bent). The two notches on each washer must fit over the two lock pins to prevent riding on the crankshaft.

Original front bearing uses a separate thrust washer. Replacement front bearing is a one piece assembly with thrust washer part of the bearing. Do not use a separate thrust washer when installing this replacement part. See Figures 16 and 17.

New camshaft bearings are precision type which do not require line reaming or line boring after installation. Coat the bearing with SAE20 oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the elongated hole in proper position and narrow section facing out (except bores without oil holes install with bearing groove at the top). Be sure to start the bearing straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in flush with the bottom of counterbore which received the expansion plug (see Figure 15).

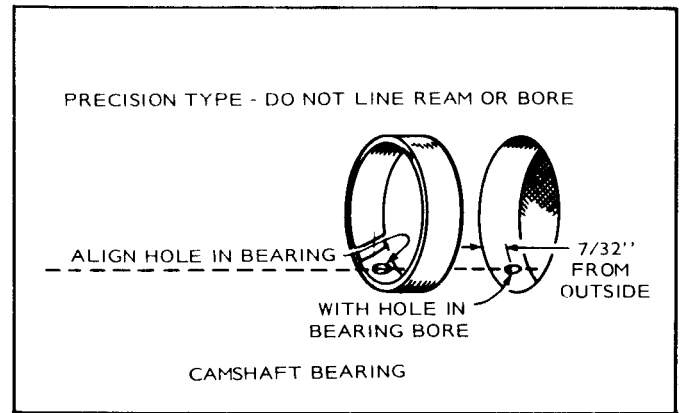


FIGURE 15. CAMSHAFT BEARING

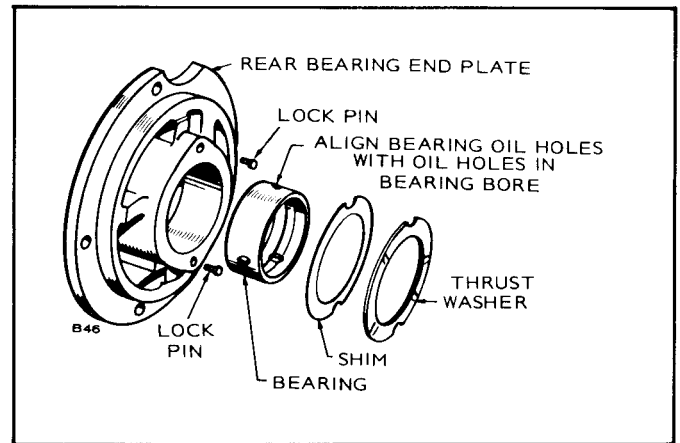


FIGURE 16. BEARINGS FOR REAR BEARING PLATE

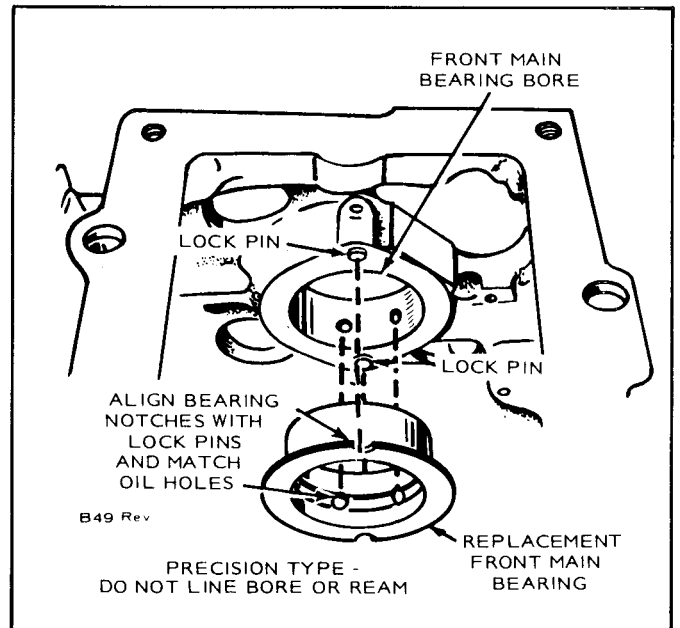


FIGURE 17. FRONT MAIN BEARING INSTALLATION

CRANKSHAFT ENDPLAY

After the rear bearing end plate has been tightened using the torque recommended in *Assembly Torques*, check the crankshaft endplay as shown in Figure 18. If there is too much endplay (see *Dimensions and Clearances* for minimum and maximum endplay), remove the rear bearing end plate and add a shim between the thrust washer and plate. Reinstall the end plate making sure the thrust washer and shim notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

Checking Bearing Clearance with Plasti-Gage:

1. Make certain that all parts are marked or identified so that they are reinstalled in their original positions.
2. Place a piece of correct size Plasti-Gage in the bearing cap the full width of the crankshaft rod surface about 1/4 inch off center (Figure 19).
3. Rotate the crank about 30 degrees from bottom dead center and reinstall the bearing cap; tighten the bolts to the torque specified in the *Table of Torques and Clearances*. Do not turn the crankshaft.
4. Remove the bearing cap. Leave the flattened Plasti-Gage on the part to which it has adhered and compare the widest point with the graduations on the Plasti-Gage envelope to determine bearing clearance.

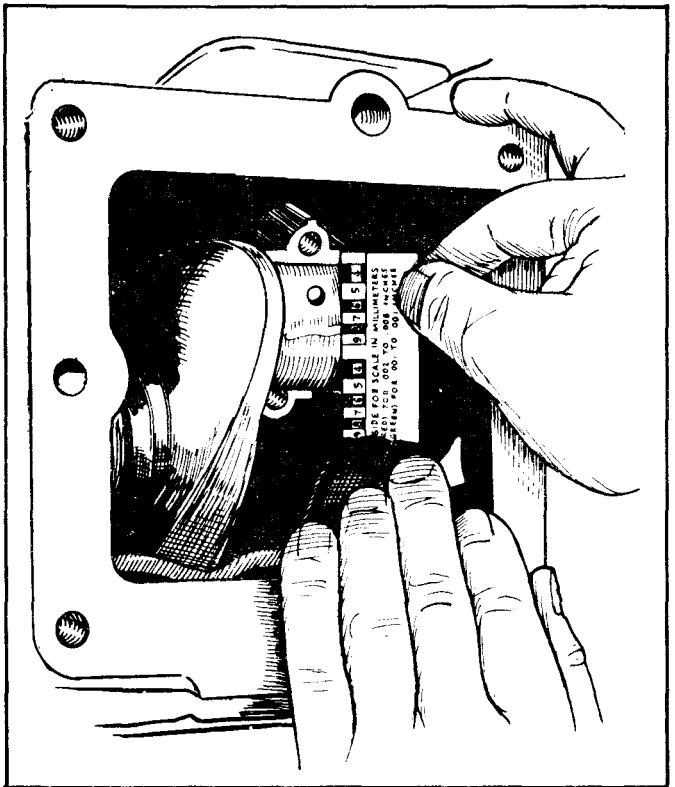


FIGURE 19. MEASURING BEARING CLEARANCE WITH PLASTI-GAGE

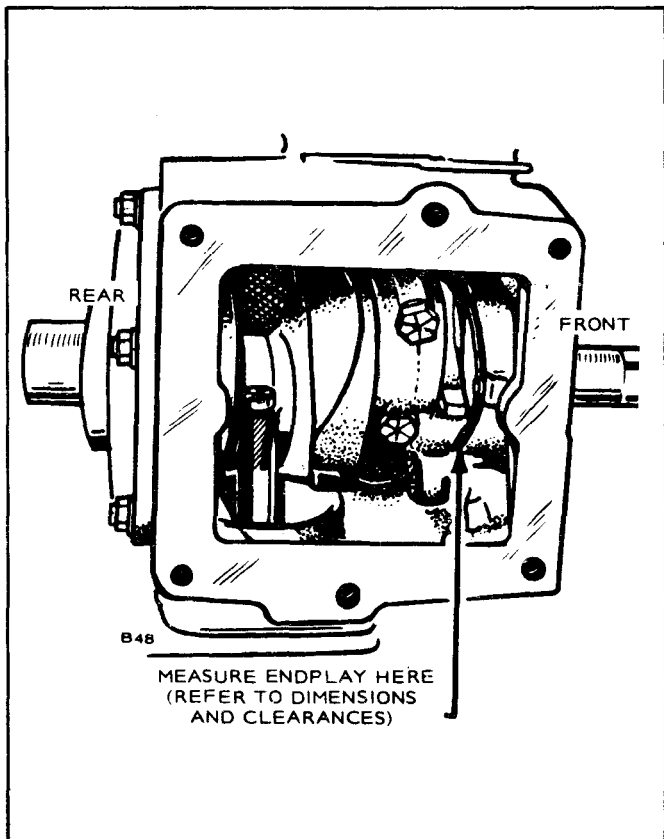


FIGURE 18. CRANKSHAFT ENDPLAY

OIL SEALS

The bearing plate must be removed to replace the oil seal. Drive the oil seal out from the inside. Before installing the seals, fill the space between lips with a multi-purpose grease. This will improve sealing. When installing the gear cover oil seal, tap the seal inward until it is 31/32 inch from the mounting face of the cover. When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

ASSEMBLY

1. Lubricate all parts with engine oil.
2. Position piston on its respective rod and install the pin.
3. Install the rings on the pistons starting with the oil control ring (Figure 21). Use a piston ring spreader to prevent twisting or excessive expansion of the ring. Some oil control rings and all compression rings have a dot or the word "top" on one side of the ring to indicate which side faces the top of the piston. Unmarked piston rings can be installed either way. If the oil control ring has a coil expander, install the expander first and then close until the coil ends butt. The joint should be 180 degrees from the gap of that ring.

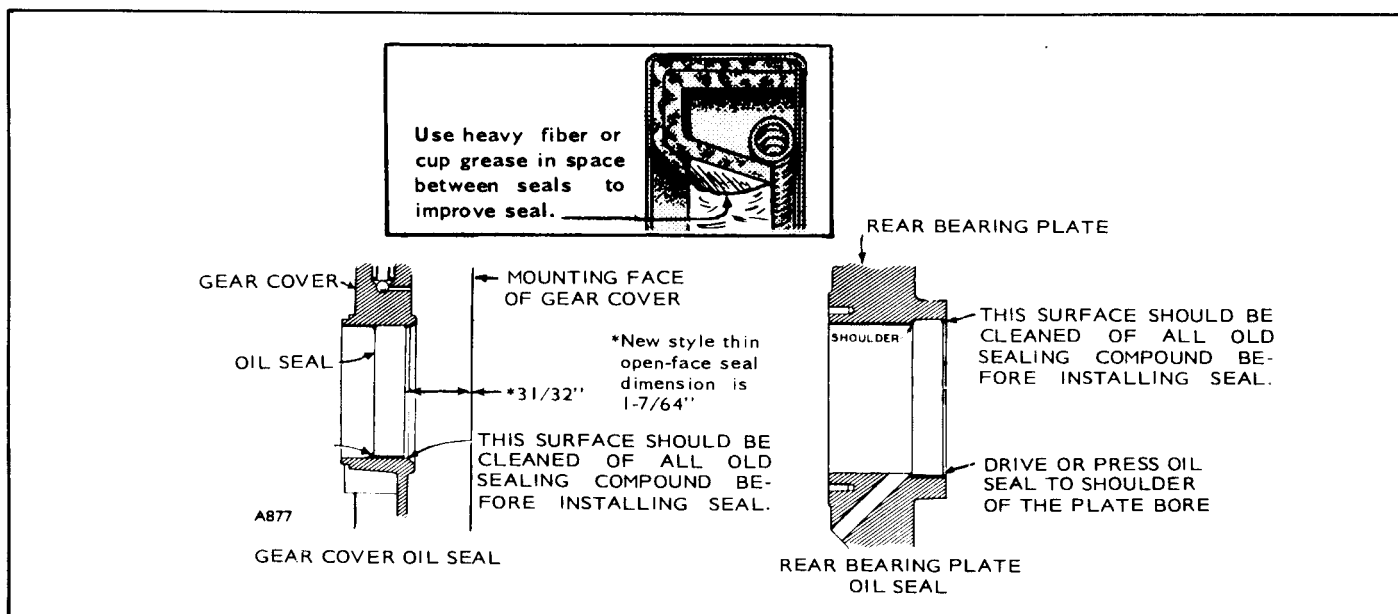


FIGURE 20. GEAR COVER AND REAR BEARING PLATE OIL SEALS

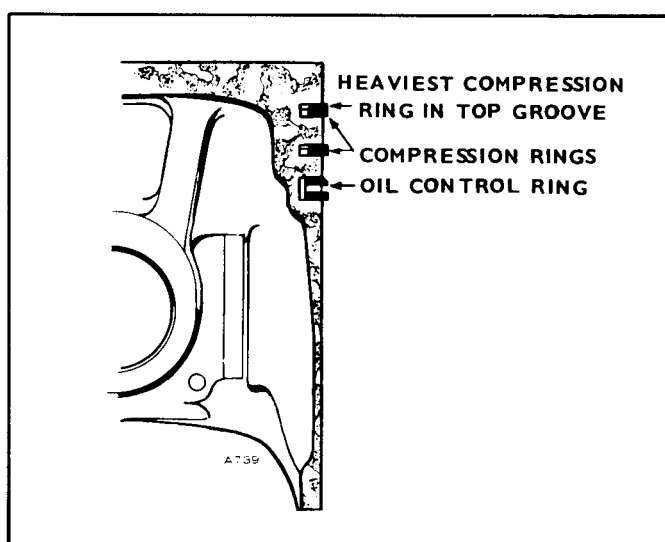


FIGURE 21. PISTON RINGS

Installation of Piston in Cylinder:

1. Turn the crankshaft to position the number one rod bearing journal at the bottom of its stroke.
2. Lubricate the number one piston assembly and inside of the cylinder. Compress the rings with a ring compressor as shown in Figure 22.
3. Position the piston and rod assembly in the cylinder block.
4. Tap the piston down into the bore with the handle end of a hammer until the connecting rod is seated on the journal (Figure 22).



Make sure edge of rod does not nick crank journal.

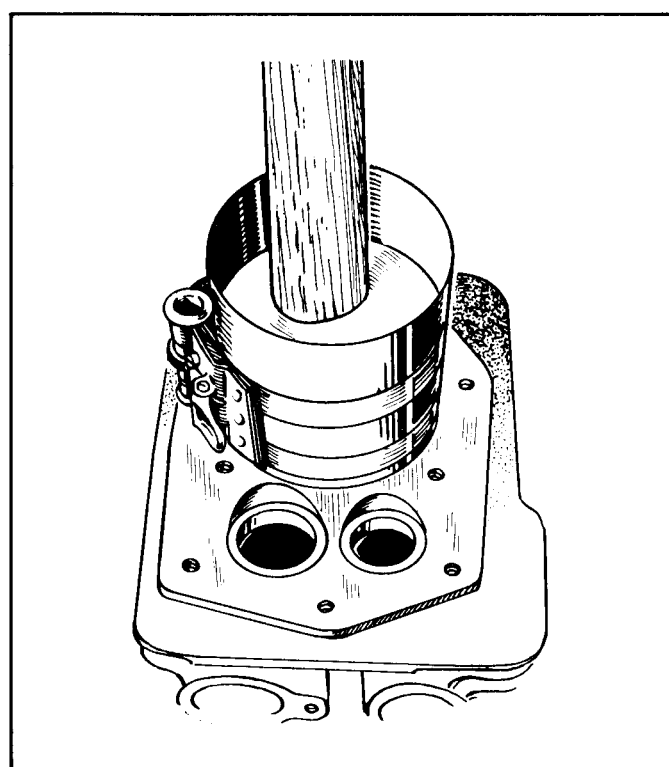


FIGURE 22. INSTALLING PISTON

Install the bearing cap on the rod with the witness marks and stamped reference numbers matching the marks on the rod. Install and tighten the bolts to the specified torques.

The bearing cap must be tapped several times to properly align it with the rest of the connecting rod. Clearance varies on the journal if this is not done.

Install the remaining pistons and rods in the same manner. Crank the engine over by hand to see that all bearings are free.

5. Install the oil base and pan using new gaskets. Torque oil base thru-bolts to 18-23 ft.-lb. Torque oil pan bolts (18) to 8-12 ft.-lb.
6. Install the cylinder heads and torque 17-19 ft. lb.
7. Replace oil and break-in engine.

CYLINDER HEADS

Remove the cylinder heads for cleaning when poor engine performance is noticed.

1. Use a 1/2-inch socket wrench to remove cylinder head nuts. Lift heads off.



Do not remove heads when they are hot. Warpage may occur.

2. After removing heads, clean out all carbon deposits. Be careful not to damage the outer sealing edges where gaskets fit. The heads are made of aluminum and can be damaged by careless handling.
3. Use new head gaskets and clean both the heads and the cylinder block thoroughly where the head gaskets rest.
4. Place heads in position and follow head torque tightening sequence shown in Figure 23. Start out tightening all nuts to 5 ft.-lb, then 10 ft.-lb, etc., until all nuts are torqued 17-19 ft.-lb.

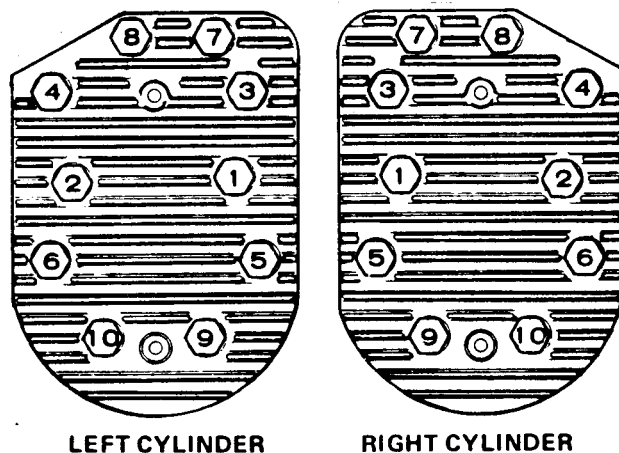


FIGURE 23. CYLINDER HEAD TORQUE TIGHTENING SEQUENCE

OIL SYSTEM

CRANKCASE OIL

Change crankcase oil every 100 operating hours and only when engine is warm. (EXCEPTION: Drain initial oil fill at 25 operating hours.)

To drain, remove the oil drain plug on oil pan. After oil drains, replace the plug and refill crankcase with 4 quarts (4-1/2 with filter change) of a good quality detergent oil. Oil must meet or exceed the API (American Petroleum Institute) designation SE or SE/CC; this oil was formerly designated as MS, MS/DG or MS/DM.

For temperatures above 30°F use SAE 30 oil; for temperatures below 30°F, use 10W or 5W30. 10W40 is a good choice for all around use and can be used throughout the year.

In extremely dusty conditions or in very cold weather, change oil at least every 50 hours of operation.

CAUTION

Do not overfill crankcase. Do not use service DS oil. Do not mix brands nor grades of motor oil.

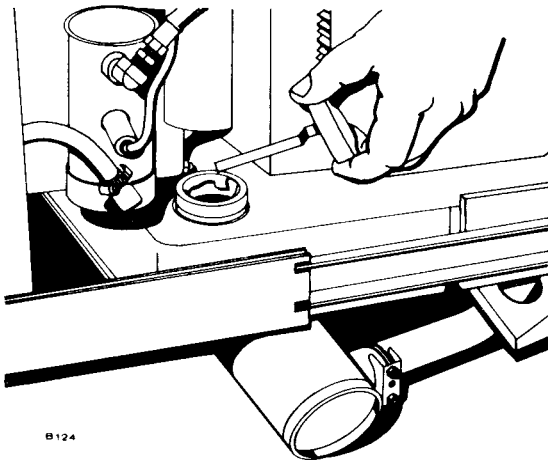


FIGURE 24. DIPSTICK LOCATION

OIL FILTER

Change the crankcase oil filter at least every 200 operating hours. Filter is located above starter on right side of engine. Remove by turning filter counterclockwise with a filter wrench. Before installing new filter, coat the gasket on base of filter with a light film of oil. Install by turning clockwise until friction is noted, then turn an additional 1/4 to 1/2 turn. See Figure 25.

CAUTION

Do not over-torque oil filter. Be sure ring is installed around oil filter. This ring acts as an air seal and prevents loss of cooling air.

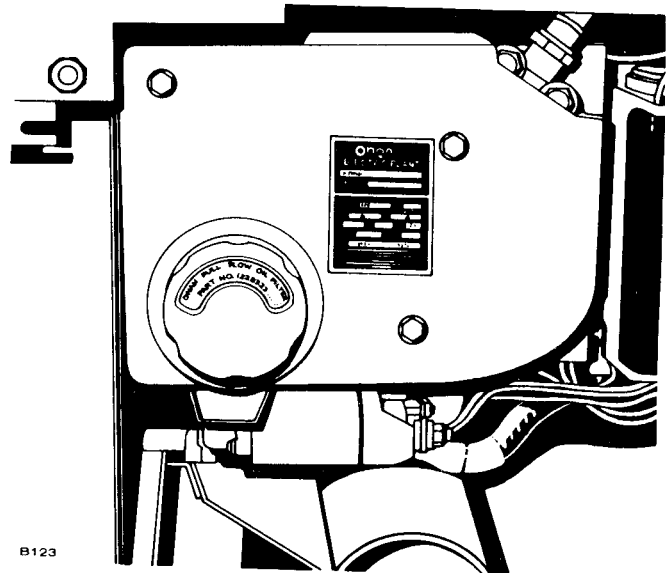


FIGURE 25. OIL FILTER LOCATION

CRANKCASE BREATHER

This engine uses a crankcase breather valve for maintaining crankcase vacuum. No maintenance is generally required. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, clean baffle and valve in a suitable solvent. (A pressurized crankcase could also be caused by overfilling with oil or leaving the fill cap loose.) Crankcase breather disassembly requires removal of exhaust manifold. See Figure 26.

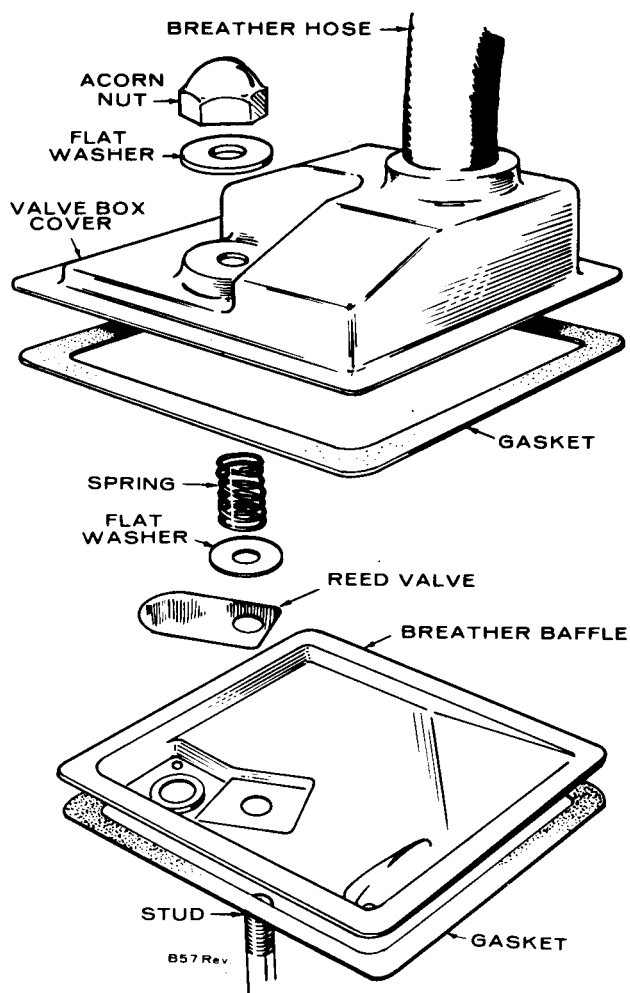


FIGURE 26. CRANKCASE BREATHER

FUEL SYSTEM

CARBURETOR DISASSEMBLY AND REPAIR

Removal:

1. Disconnect fuel inlet hose, crankcase breather hose and air inlet hose.
2. Disconnect governor, throttle linkage, and choke control.
3. Remove two hold-down nuts and lift carburetor from intake manifold.

Always work on carburetor in clean conditions.

Replacing Needle and Valve Seat:

1. Remove 7/16 inch hex at base of fuel bowl and lift bowl from carburetor.
2. Push out pin that holds float to carburetor body.
3. Remove float and set aside in a clean place. Pull out needle and using a large screwdriver remove needle valve seat.
4. Install new valve seat and needle and replace float.
5. Adjust float.

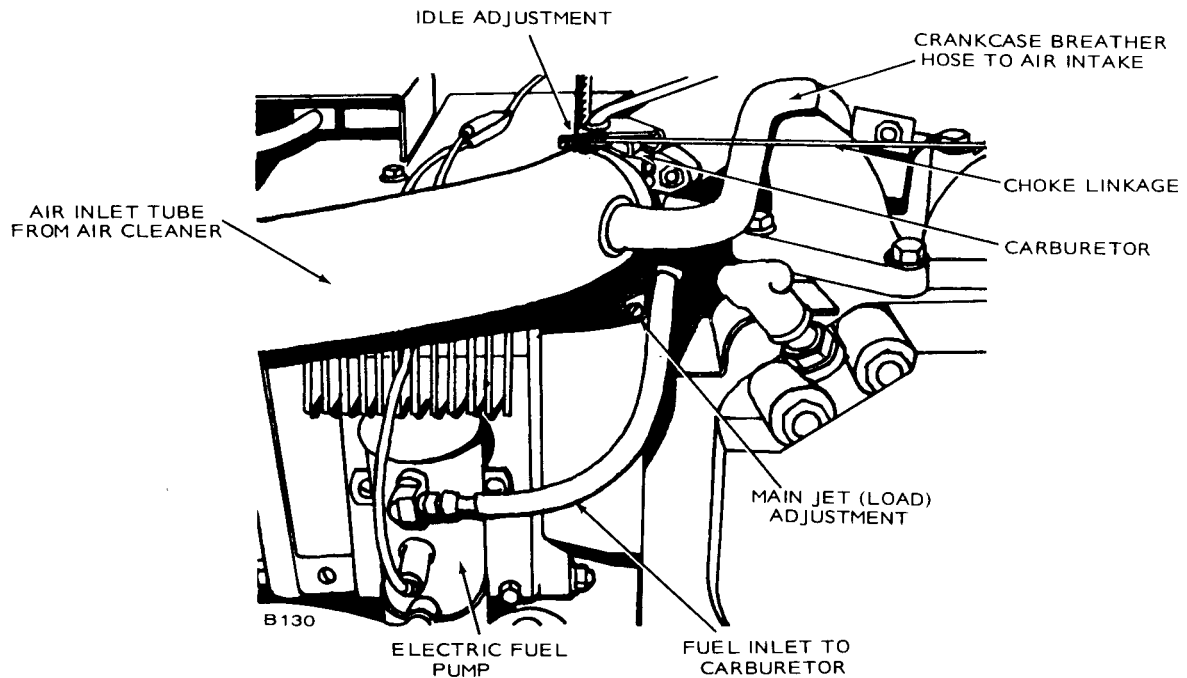


FIGURE 27. FUEL SYSTEM

CARBURETOR FLOAT ADJUSTMENT

1. Invert float and casting.
2. With the float resting lightly against the needle and seat, there should be .07 to .11 inch clearance between base of float and carburetor casting.

A drill bit can be used for this measurement as shown in Figure 28. Use a 3/32 inch drill bit or any bit between .07 inch (No. 50) and .11 inch (No. 35).

3. If it is necessary to reset float level, remove the float from carburetor and bend the float tang, near the pin, to obtain correct float level.

CAUTION

Do not bend the float when installed; doing so may cause deformation of needle or seat.

4. Check the float closely for signs of leakage. Repair or replace float if damaged or filled with gasoline.
5. Before assembling carburetor, remove filter screen from float bowl and clean both screen and base of float bowl.
6. Install new gaskets when reassembling.

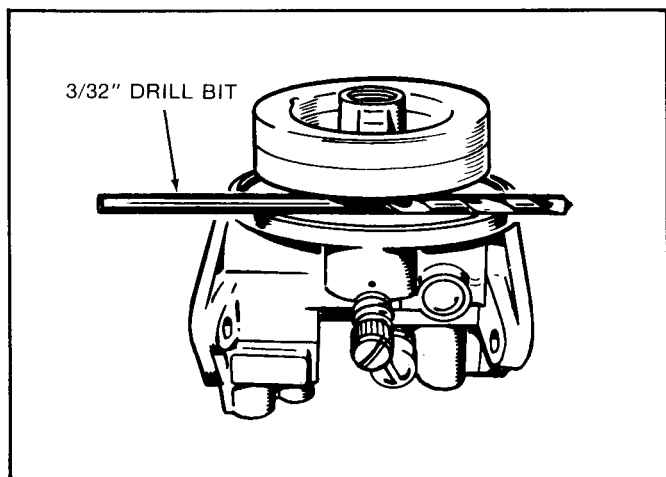


FIGURE 28. CARBURETOR FLOAT ADJUSTMENT

CARBURETOR CLEANING AND INSPECTION

To clean the carburetor, soak all components thoroughly in a good carburetor cleaner, following the manufacturer's instructions. Be sure to remove all carbon from carburetor bore, especially in the area of the throttle valve. After soaking, clean out all passages with filtered, compressed air.

Check the adjusting needles and nozzle for damage. If float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding.

Check the choke and throttle shafts for excessive side play and replace if necessary. Figure 29 shows an exploded view of carburetor.

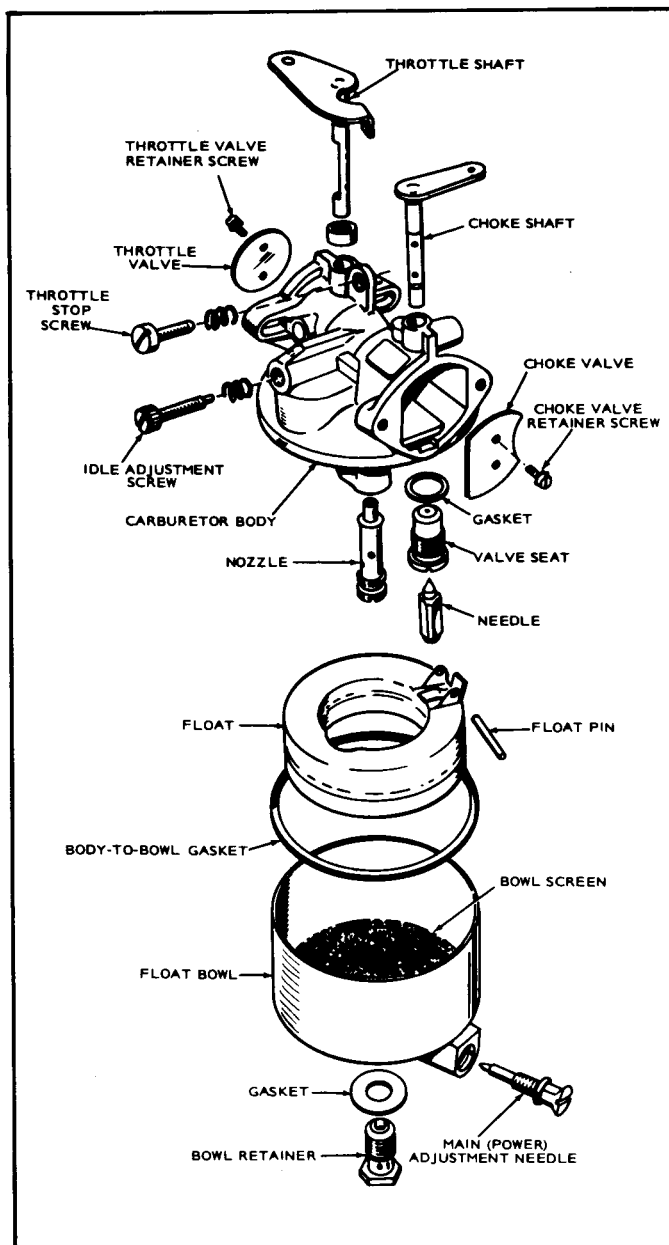


FIGURE 29. EXPLODED VIEW OF CARBURETOR

FUEL PUMP FILTER ELEMENT

Every 500 hours or sooner, drain fuel pump and check filter element. Remove fuel pump mounting screws and turn off hex nut on base of pump. If element appears dirty, replace with a new one. Be sure to replace gaskets when reassembling.

AIR CLEANER ELEMENT

Check and clean element at least every 100 hours. Loosen wing nut to remove. Clean by tapping base lightly on a flat surface. Replace element at least every 500 operating hours; clean or replace more often in dusty conditions.

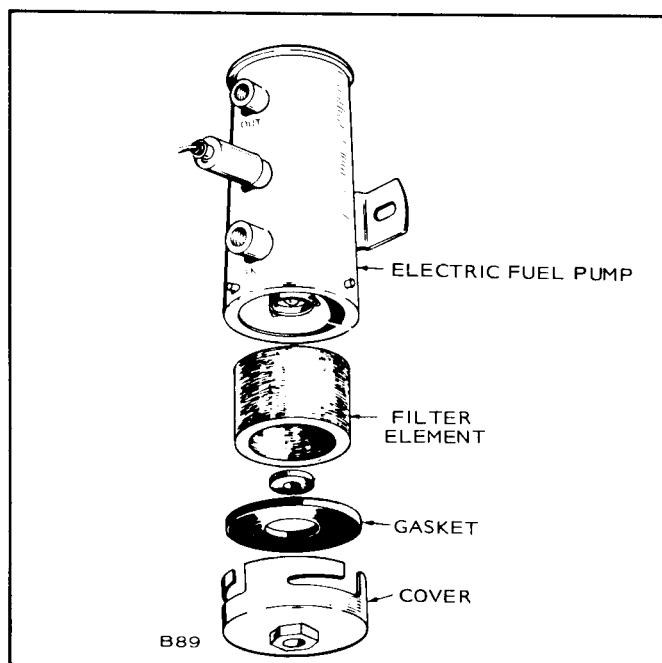


FIGURE 30. FUEL PUMP FILTER ELEMENT

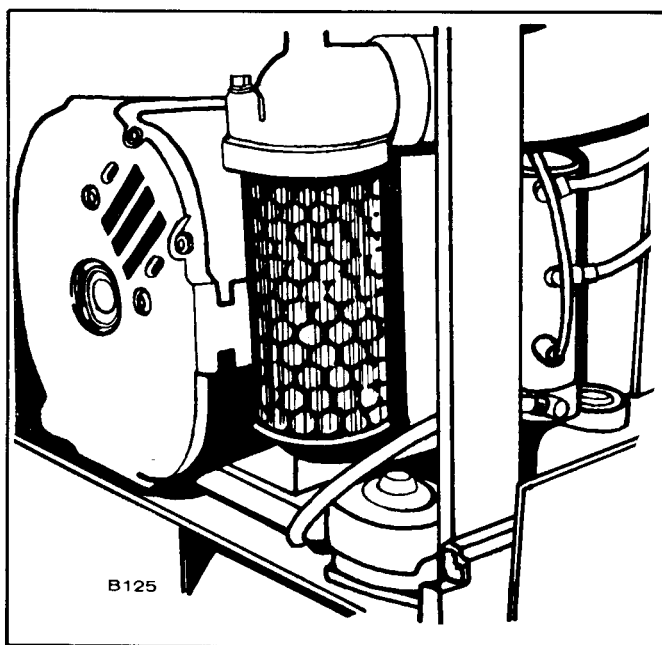


FIGURE 31. AIR CLEANER ELEMENT

CARBURETOR BOWL

Remove carburetor bowl every 500 hours and clean filter screen in solvent. Blow out with low pressure compressed air and reassemble, making sure gaskets are in place.

GOVERNOR BALL JOINT

Every 200 hours or sooner, check the governor linkage for freedom of movement through its travel. Clean and lubricate ball joint with lubricating graphite.

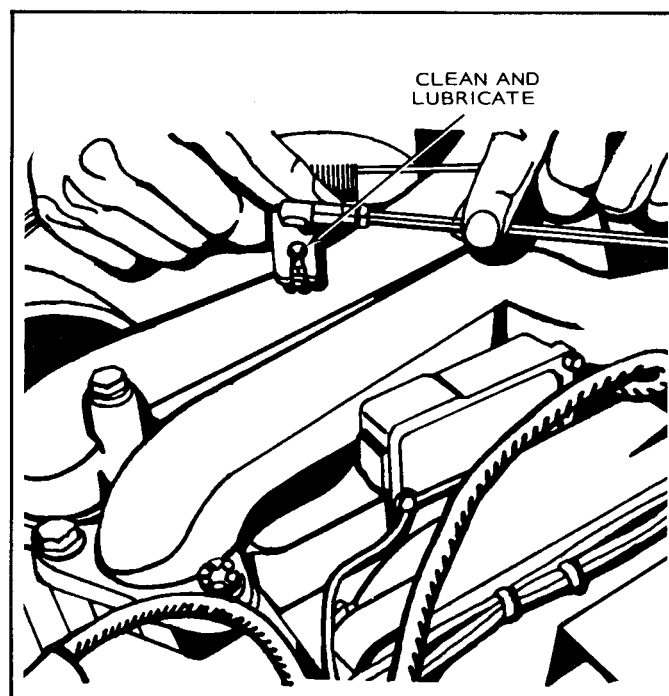


FIGURE 32. GOVERNOR BALL JOINT

CARBURETOR ADJUSTMENTS

The carburetor has a main fuel (power) adjustment and an idle fuel adjustment. The main adjustment affects operation under heavy load conditions. Idle adjustment affects operation under light or no load conditions. Under normal circumstances, factory carburetor adjustments should not be disturbed. Normal settings are 1-1/4 turn open for main fuel jet and one turn open for idle fuel jet.

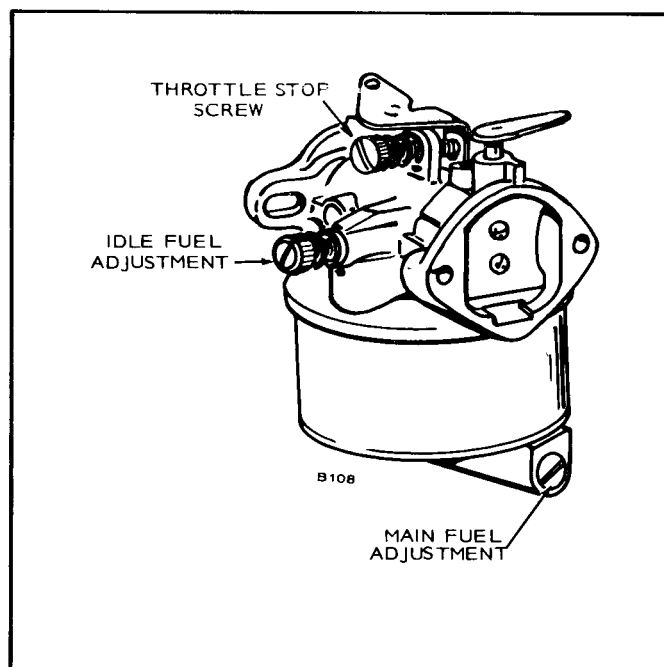


FIGURE 33. CARBURETOR ADJUSTMENTS



CAUTION Forcing the needle against its seat will damage it. The needle does not completely shut off fuel when turned fully in.

Before final adjustment, allow the engine to warm up. Make the idle adjustment under no load. Open the main jet until the engine runs smooth under acceleration with no load. Slightly more fuel may be needed (open about 1/4 turn further) when sudden load is applied or if operating in very cold weather.

Set the throttle stop screw (located on carburetor throttle lever) with no load connected and while running at a low speed setting. Turn the screw to give approximately 1/32 inch clearance between the screw and pin.

If the engine develops a "hunting" condition (alternate increase and decrease of engine speed), try correcting by opening the main adjusting needle a little more. Do not open more than 1/2 turn beyond the maximum power point.

GOVERNOR

Before making governor adjustments, run the unit about 15 minutes under light load to reach normal operating temperature. (If governor is completely out of adjustment make a preliminary adjustment at no load to first attain a safe voltage operating range.)

Engine speed determines the output voltage and current frequency of the generator. By increasing the engine speed, generator voltage and frequency are increased, and by decreasing the engine speed, generator voltage and frequency are decreased. An accurate voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor. A small speed drop not noticeable without instruments will result in an objectionable voltage drop. The engine speed can be checked with a tachometer.

A binding in the bearings of the governor shaft, in the ball joint, or in the carburetor throttle assembly will cause erratic governor action or alternate increase and decrease in speed (hunting). A lean carburetor adjustment may also cause hunting. Springs of all kinds have a tendency to lose their calibrated tension through fatigue after long usage. If all governor and carburetor adjustments are properly made, and the governor action is still erratic, replacing the spring with a new one and resetting the adjustments will usually correct the trouble.

1. Adjust the carburetor idle needle with no load connected.
2. Adjust the carburetor main jet for the best fuel mixture while operating the set with a full rated load connected.
3. Adjust the length of the governor linkage and check linkage and throttle shaft for binding or excessive looseness.
4. Adjust the governor spring tension for rated speed at no load operation.
5. Adjust the governor sensitivity.
6. Recheck the speed adjustment.
7. Set the carburetor throttle stop screw.

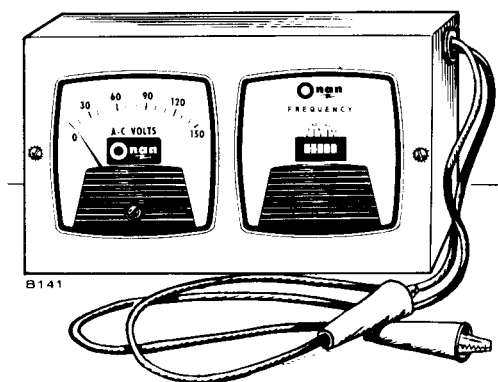


FIGURE 34. AC VOLTAGE AND FREQUENCY TESTER

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft and lever is adjusted by rotating the ball joint. Adjust this length so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle lever just contacts the boss on the carburetor body. This setting allows immediate control by the governor after starting. It also synchronizes travel of the governor arm and the throttle shaft.

Speed Adjustment: With the warmed-up unit operating at no load, adjust the tension of the governor spring. Refer to *Voltage Chart* and the *Speed Chart* and select the column which corresponds to the nameplate of the unit in question. Turn the speed adjusting nut to obtain a voltage and speed reading within the limits shown.

Sensitivity Adjustment: Refer to the *Governor Adjustment* illustration, and to the *Voltage and Speed Charts*. Check the voltage and speed, first with no load connected and again with a full load. Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition.

To increase sensitivity (closer regulation), shift the spring toward the governor shaft.

An adjustment for too much sensitivity will cause alternate increase and decrease of engine speed (hunting).

To decrease sensitivity, shift the spring toward the outer end of the governor arm. Too little sensitivity will result in too much difference in speed between no load and full load conditions.

Any change in the sensitivity adjustment usually requires a compensating speed (spring tension) adjustment.

ELECTRIC CHOKE

Manually check movement of choke travel to be sure it is not stuck open or closed. Voltage at choke should be 12 volts during start and drop to zero during run. If choke does not move at room temperature with 12 volts applied, replace.

This choke should not require any seasonal readjustment. If adjustment becomes necessary proceed as follows:

1. Remove clip and bushing.
2. Loosen choke lever clamp screw.
3. With lever fully forward (away from carburetor), adjust so choke valve is completely closed.
4. Tighten clamp screw.
5. Replace bushing and clip.

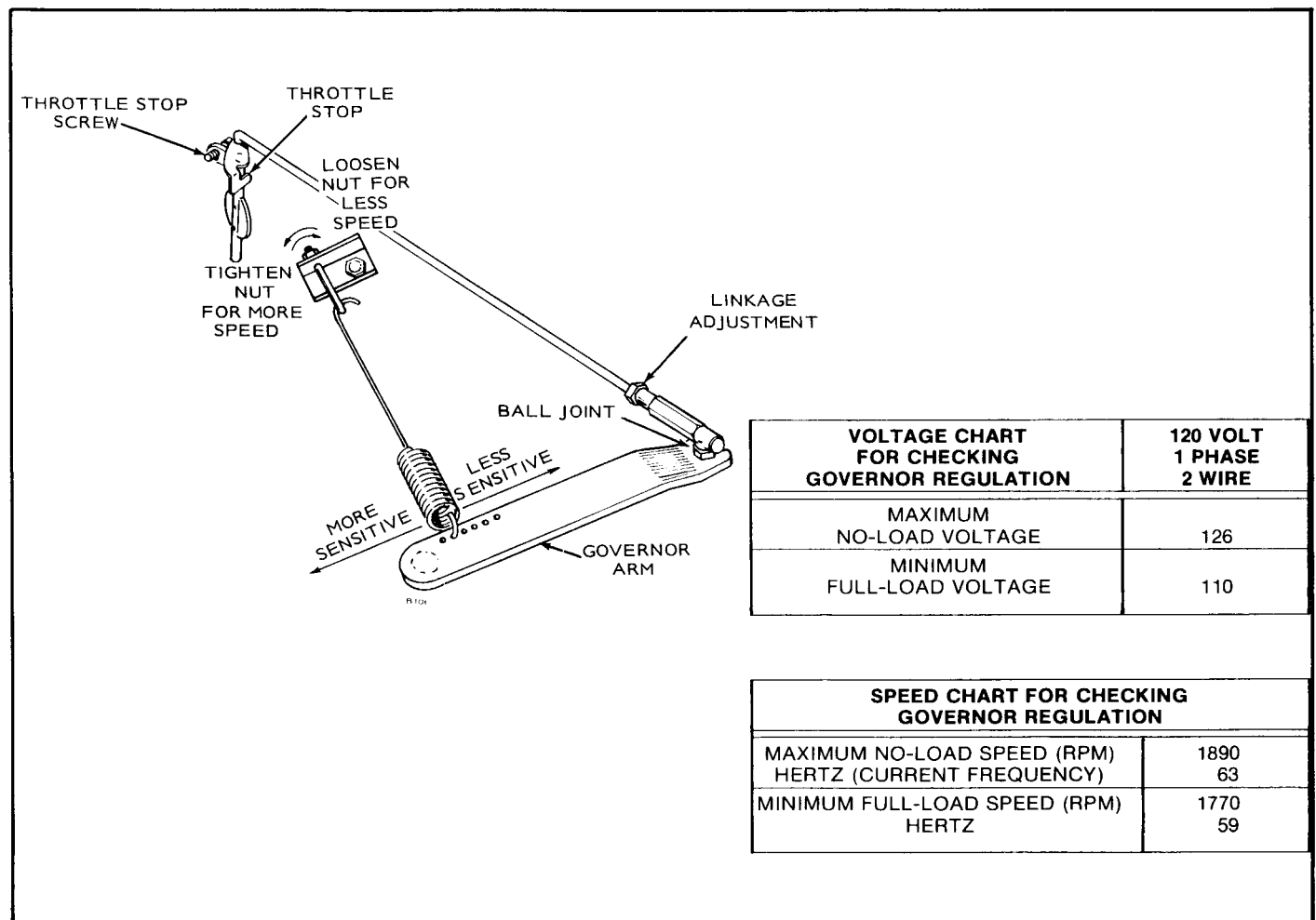


FIGURE 35. GOVERNOR ADJUSTMENTS

FUEL SYSTEM TROUBLESHOOTING GUIDE

TROUBLE	CAUSE	REMEDY
FUEL LEAKS FROM CARBURETOR WHEN FUEL SHUT-OFF IS OPEN	1. Float level set too high	1. With fuel bowl removed and carburetor inverted, set float parallel to bowl flange (3/32" clearance)
	2. Dirt under inlet valve	2. Remove inlet valve, clean seat by rinsing in clean fuel and blow off with compressed air
	3. Bowl vent plugged	3. Remove bowl and blow clean with compressed air
	4. Collapsed float caused by blowing assembled carburetor with compressed air	4. Replace float
	5. Carburetor gummed from storage. Float stuck to screen	5. Remove fuel bowl and clean with suitable solvent.
ENGINE SMOKES AND RUNS RICH	1. Dirty air filter	1. Clean or replace
	2. Improper adjustment	2. Set idle and power needles at one turn open. After engine starts and runs, set for optimum performance
	3. Nozzle boss gasket leaks. Engine runs with power needle seated	3. Remove fuel bowl and replace gasket. Tighten bowl retainer securely
	4. Air bleeds in carburetor plugged	4. Remove fuel bowl, idle and power needles. Clean thoroughly with compressed air.

FUEL SYSTEM TROUBLESHOOTING GUIDE

(Continued)

TROUBLE	CAUSE	REMEDY
ENGINE RUNS LEAN	1. Improper adjustment	1. Set idle and power needles at one turn open. After engine starts and runs, set for optimum performance
	2. Idle holes plugged. Dirt in fuel delivery channels	2. Remove fuel bowl, idle and power needles. Clean thoroughly with compressed air
	3. Float level set too low. Low level in fuel bowl	3. With fuel bowl removed and carburetor inverted, set float parallel to bowl flange (3/32" clearance)
	4. Fuel filter in electric fuel pump dirty	4. Remove filter and replace
	5. Fuel filter (screen) in bowl plugged	5. Remove fuel bowl. Clean thoroughly and replace
ENGINE STARTS HARD	1. Improper adjustment	1. Set idle and power needles at one turn open. After engine starts and runs, set for optimum performance
	2. No fuel in carburetor	2. Check carburetor drain valve. If no fuel in bowl clean tank filter and carburetor. Check electric fuel pump operation.
	3. Choke valve not closing	3. Check controls for proper travel
GOVERNOR SURGE	Throttle shaft and valve binding	Remove and replace shaft if worn. Clean carburetor body. Reassemble throttle shaft assembly into carburetor body as far as possible. Hold firmly in place in this position while assembling throttle valve. Make certain valve does not bind in throttle bore when opening and closing throttle.

IGNITION AND BATTERY CHARGING

BREAKER POINT (Cold Setting)

To maintain maximum efficiency from the engine, change the breaker points every 200 hours of operation. Proceed as follows:

1. Remove the two screws and the cover on the breaker box.
2. Remove the two spark plugs so engine can be easily rotated by hand. Check condition of spark plugs at this time.
3. Refer to Figure 36. Remove mounting nut (A) and pull the points out of the box just far enough so screw (B) can be removed and leads disconnected.
4. Remove screw (C) and replace condenser with a new one.
5. Replace points with a new set but do not completely tighten mounting nut (A).
6. A small hole on rear of blower housing provides an access to view timing mark (Figure 37).
7. Rotate the engine clockwise (facing flywheel) by hand until the 25°BTC mark aligns with hole. Turn another 1/4 turn (90°) to ensure points are fully open.
8. Using a screwdriver inserted in notch (D) on the right side of points, turn points until gap measures .020 inch with a flat thickness gauge. (Be sure feeler is clean.) Tighten mounting screw and recheck gap. Timing is automatically set at 25°BTC when point gap is .020 inch.

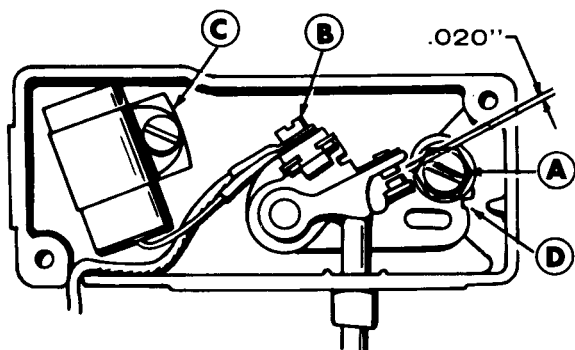


FIGURE 36. BREAKER POINT ADJUSTMENT

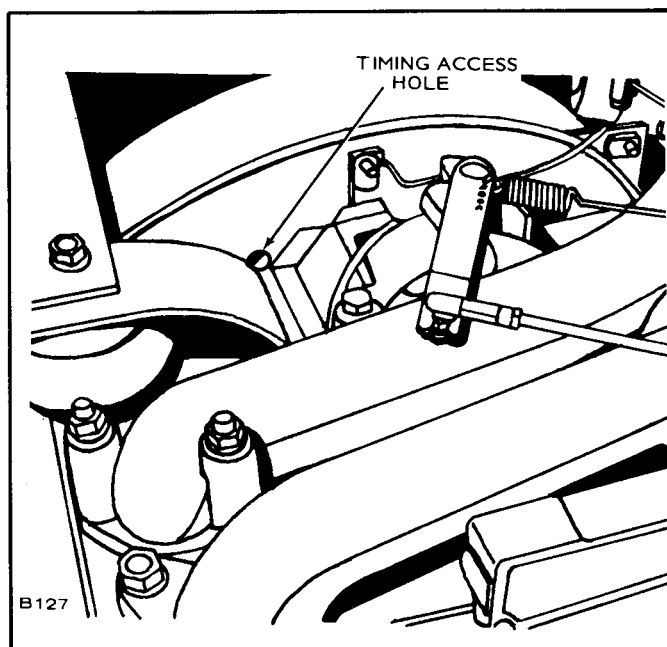


FIGURE 37. TIMING ACCESS HOLE

IGNITION TIMING

The timing on the engine is preset at the factory. A non-movable breaker point box is used, however a slight timing change could be made by adjusting points.

The engine is equipped with an automotive type battery ignition system. Both spark plugs fire simultaneously, thus the need for a distributor is eliminated. Spark advance is set at 25° BTC (before top center) and should be maintained for best engine performance. (Check timing if in doubt about point gap.) Proceed as follows:

Timing Procedure - Engine Running (Hot Setting)

1. To check the ignition timing with unit running, use a timing light. Connect the timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.
2. A small hole on the rear portion of blower housing provides an access to view timing marks. Two marks are provided; one for T/C (top center) and one for 2/5 (25° BTC).

3. Start the engine and check the timing. The 25° mark on the flywheel should line up in the middle of the hole.
4. Replace breaker box cover and any other hardware removed from engine.

Timing Procedure - Engine Not Running (Cold Setting)

1. Connect a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.
2. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
3. The lamp should go out just as the points break which is the time at which ignition occurs (25° BTC).

SPARK PLUGS

Remove both spark plugs and install new ones every 100 hours. Use Onan 167-0245 or equivalent. Check to be sure spark plug gap is set at .020.

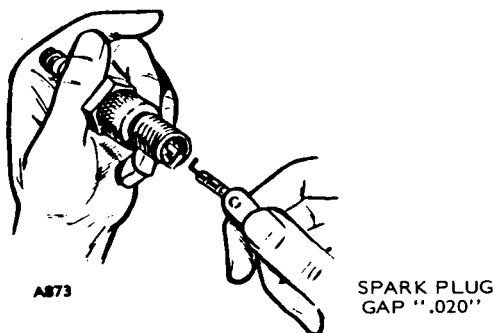


FIGURE 38. SPARK PLUG GAP

IGNITION COIL

To test primary and secondary windings within the ignition coil proceed as follows:

1. Use a Simpson 260 VOM or equivalent.
2. Place black lead on ground (-) terminal of coil and red lead to positive (+) terminal. Primary resistance should read 4.30 (± 10%) ohms.
3. Change resistance setting on ohmmeter. Place ohmmeter leads inside of spark plug cable holes (Figure 39). Secondary resistance should read 14,000 (+10%) ohms.
4. If any of the above conditions are not met, replace coil.

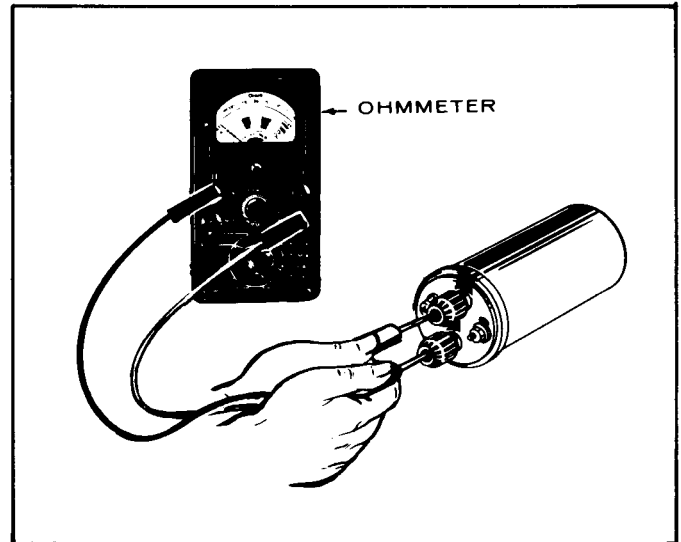


FIGURE 39. COIL TEST

CAUTION

This engine uses a 12 volt, negative ground system. Alternator must be connected to battery at all times when engine is running. Do not reverse battery cables.

Battery Inspection: Check battery cells with a hydrometer. The specific gravity reading should be approximately 1.280 at 80°F.

If one or more cells are low on water, add distilled water and recharge.

Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or grease to retard corrosion.

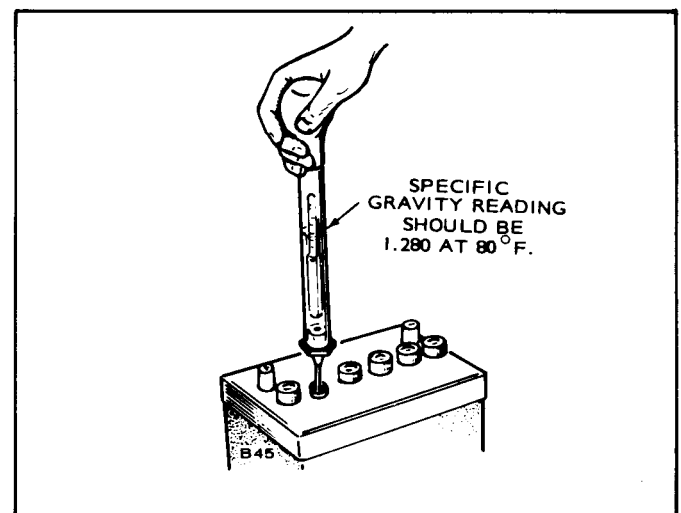


FIGURE 40. SPECIFIC GRAVITY TEST

FLYWHEEL ALTERNATOR

This unit is equipped with a permanent magnet flywheel alternator and solid-state voltage regulator-rectifier (output control). As with all solid-state electrical units, precautions are necessary when servicing. Observe the following:

Precautions:

1. Do not connect battery cables in the wrong polarity.
2. Do not short together alternator stator leads.
3. Do not run without a battery. Damage will occur to regulator and battery ignition coil.

Preservice Checks:

1. Check for a good ground between equipment and regulator-rectifier case.
2. Be sure output control plug (connector) is properly inserted into stator receptacle. This means the plug must push in and solidly bottom in the receptacle to eliminate any resistance due to a poor connection. Keep it clean and tight.
3. Check battery and its connection to be sure it is serviceable.

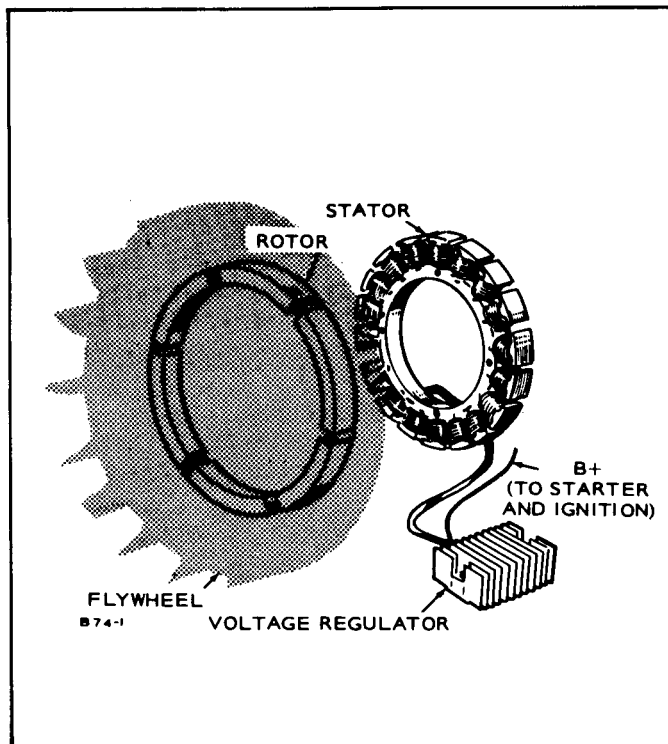


FIGURE 41. FLYWHEEL ALTERNATOR SYSTEM



Charging system tests require a fully charged battery.

TESTING BATTERY CHARGING SYSTEM

BASIC TEST	PROCEDURE	TEST VALUES
1. Battery	Battery Voltage - unit not running	12 VDC
2. Regulator	Battery Voltage after unit is running 3 to 5 minutes.	13.6 to 14.7 VDC
3. Alternator Stator and Wiring with Fully Charged battery.	Ohmmeter reading from stator output - unit not running. Disconnect wire terminating at AC terminal of voltage regulator and wire terminating at BAT terminal of start solenoid. Insert ohmmeter between these wires.	.2 to .6 Ohms
4. Alternator Stator and Wiring	Measure AC stator output voltage with unit running. Disconnect wire terminating at AC terminal of voltage regulator. Measure AC voltage (unit running) between this wire and BAT terminal of start solenoid.	28 VAC

STARTING SYSTEM

SPECIFICATIONS

Engaging System	Solenoid-operated Over-running Clutch
Nominal Output	1.0 HP
Rated Voltage	D.C. 12 V.
Field Connection	Series
Direction of Rotation	Counterclockwise (Viewing from pinion end)
Weight	3.7 lbs.

STARTER DISASSEMBLY

After removing the starter from the engine, disassemble as follows:

1. Loosen the nut that attaches the solenoid motor terminal to the field coil connector lead and take off the connector lead.
2. Loosen the retaining screws and remove the solenoid from the front bracket. Simultaneously, the fiber washers, the return spring and the solenoid plunger will be removed.
3. Unscrew the through bolts and the screws attaching the brush holder assembly to the rear bracket, so the rear bracket will be removed from the yoke.
4. Remove the yoke with the brush holder assembly.
5. Removing the brushes from the brush holders permit separation of brush holder assembly from the field coil.
6. Remove the armature from the front bracket. Simultaneously, the shift lever, the lever spring and the spring holder will be removed.
7. To remove the overrunning clutch, put a metal cylinder of suitable size over the end of armature shaft so it rests on the stop ring. Tap cylinder lightly with hammer, the stop ring sliding toward armature and off ring. Remove the ring from groove in shaft and then slide the overrunning clutch and the stop ring from the armature shaft.

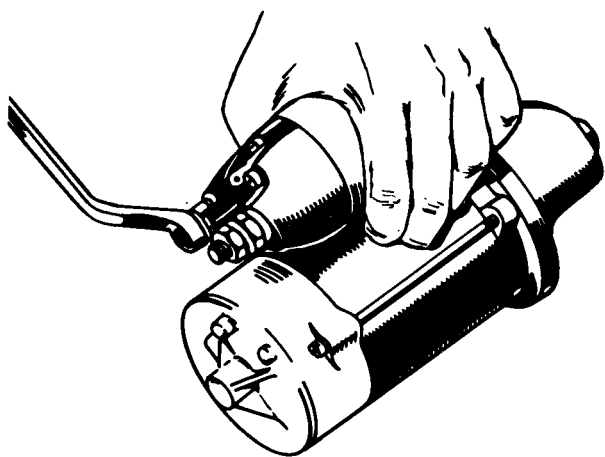


FIGURE 42.

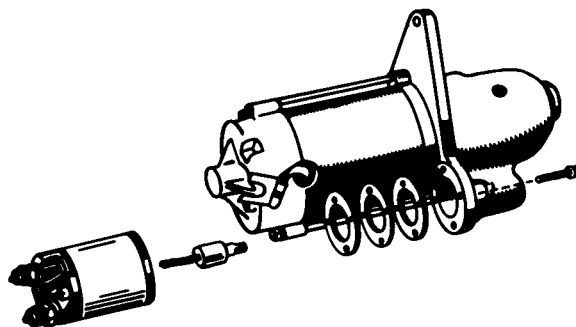


FIGURE 43.

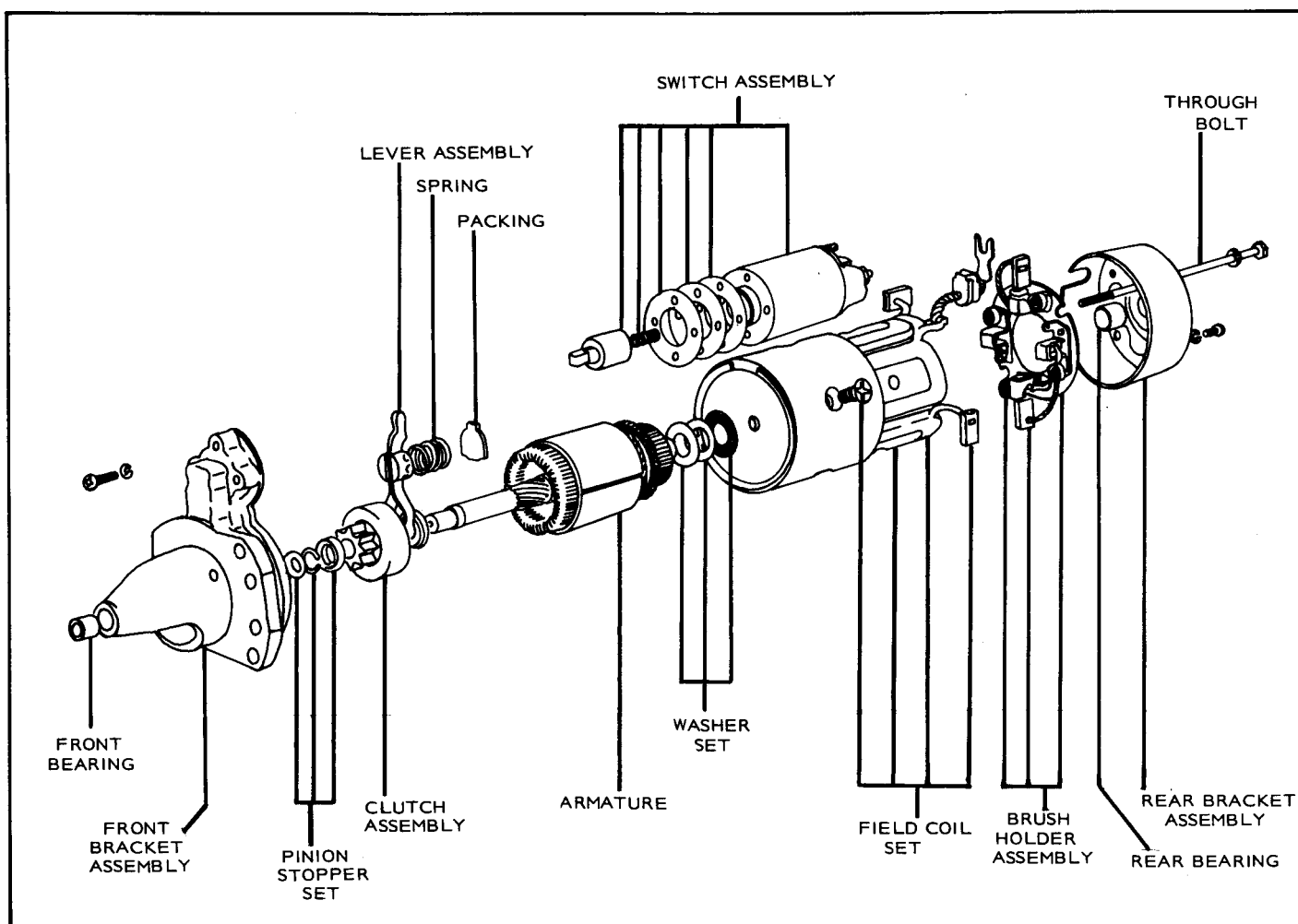


FIGURE 44. STARTER EXPLODED VIEW

CLEANING PARTS

1. **DO NOT** immerse parts in cleaning solvent. Immersing the field coil, yoke assembly, armature and solenoid will damage insulation. Wipe these parts with a cloth only.
2. **DO NOT** immerse the overrunning clutch in cleaning solvent. The clutch is prelubricated at the factory, and solvent will wash lubrication from clutch.
3. Wash all other parts in solvent and dry the parts.

INSPECTING PARTS

Inspection for Grounded Armature: Grounds in the armature can be detected by using a test lamp. If the lamp lights when one probe of test lamp is touched to the commutator with other probe to the core, the armature is grounded.

Inspection for Shorted Armature: A short circuit in the armature can be located by using a growler tester. Place armature in growler and hold a thin steel blade parallel to the core and just above it while slowly rotating armature in growler. A shorted armature will cause blade to vibrate and be attracted to the core.

Inspection for Open Circuit in Armature: The most likely place to look for an open circuit is at the commutator bar riser. Inspect for loose connections on the points where the conductors are joined to the commutator bars.

Commutator Runout: Place armature in pair of V-blocks, and measure runout with dial indicator. Measure both shaft and commutator. A bent shaft requires replacement of armature. When commutator runout exceeds 0.004 inch, commutator should be refaced. Remove only a sufficient amount of metal to provide a smooth, even surface.

Inspection for Open in the Field Coil: Connect both test lamp probes to the brushes of field coil ends. If the lamp does not light, the field coil is open.

Inspection for Grounded Field Coil: Connect one probe of test lamp to the yoke and another probe to the field coil. If the lamp lights, the field coil is grounded.

Inspecting Insulated Brush Holder for Grounds: Touch each of the brush holders with one test probe, while holding other test probe against brush plate. Two brush holders that are 180 degrees apart should cause test lamp to light as they are intentionally grounded. The other two brush holders should not cause lamp to light when tested as they are insulated.

If insulated brush holders cause lamp to light when tested, it indicates that brush holders on brush plate are grounded. Replace brush assembly if brush holders are grounded.

Brushes: When brush length becomes shorter than 0.45 inch, it should be replaced. Always replace brushes as a complete set.

Check the brushes for freedom of movement in the brush holders.

Brush Springs: The spring tension should be checked by placing the brush holder assembly in place on the commutator. Hook a spring scale under the spring near the end and pull scale and take a reading just as spring end leaves the brush.

Spring tension should be 49 to 59 ounces.

Replace springs that do not meet specifications.

Overrunning Clutch: The pinion gear should rotate smoothly in one direction (not necessarily easily), but should not rotate in opposite direction. If the pinion gear does not function properly, or if pinion gear is worn or burred, replace the overrunning clutch unit.

REASSEMBLY

Reassembly is the reverse of disassembly.

1. Lubricate armature shaft splines with a very light grade oil. A medium or heavy oil and grease may cause the overrunning clutch assembly faulty operation in cold weather.

2. Install the overrunning clutch assembly, the ring and the stop ring on the armature shaft.
3. Apply a small amount of lubriplate on the shift lever pivot pin and the lever holders.

Install the shift lever over the clutch assembly with position indicated in Figure 45. This is important, if the shift lever is not properly positioned the pinion gear travel will be restricted causing a locking in the clutch mechanism.

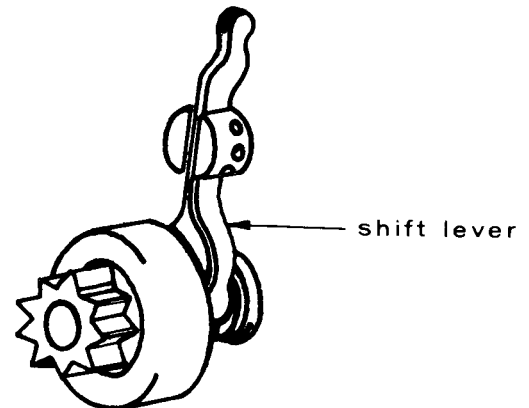


FIGURE 45. SHIFT LEVER

4. Apply a film of medium engine oil to the drive end of the armature shaft.

Place the thrust washer on the drive end of the shaft. Slide the armature with the lever into the front bracket.

5. Place the lever spring and the spring holder into the front bracket in the direction shown in Figure 46.

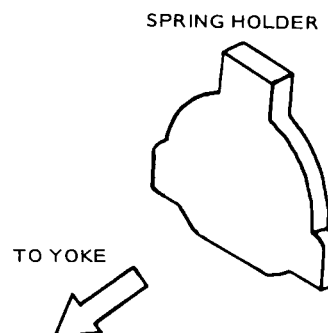


FIGURE 46. SPRING HOLDER

6. Before installing the yoke, note the position of the holes of front bracket in which the through bolts are fastened. Position the yoke to the front bracket. Be sure that the yoke is properly indexed to the front bracket.
7. Position the brush holder assembly indexing the cuts of the brush plate to the holes of the front bracket.
8. Install the brushes in their brush holders. Be sure to center the brush springs on the brushes.
9. Place the thrust washers on the commutator end of the armature shaft and apply a small amount of lubricate on the shaft.

The fiber washer is placed between the steel washers.

10. Position the rear bracket to the yoke, inserting the rubber gasket to the slot of the rear bracket.
11. Align the holes in brush plate with holes in the rear bracket and install two screws attaching the brush holder assembly to the rear bracket.
12. Fasten through bolts securely.
13. Install the solenoid plunger over the top of the shift lever in the front bracket. Be sure that the pinion gear is moved when the plunger is pulled manually.
14. Install the solenoid.

The return spring, in this case, should be straight in the proper position between the bore of the solenoid and the bore of the plunger.

TESTING AND ADJUSTING

Adjusting Pinion Clearance: After the starter is reassembled, the pinion clearance must be adjusted to give sufficient clearance between the end of the pinion and the stop ring when the pinion is in mesh with the ring gear of the engine.

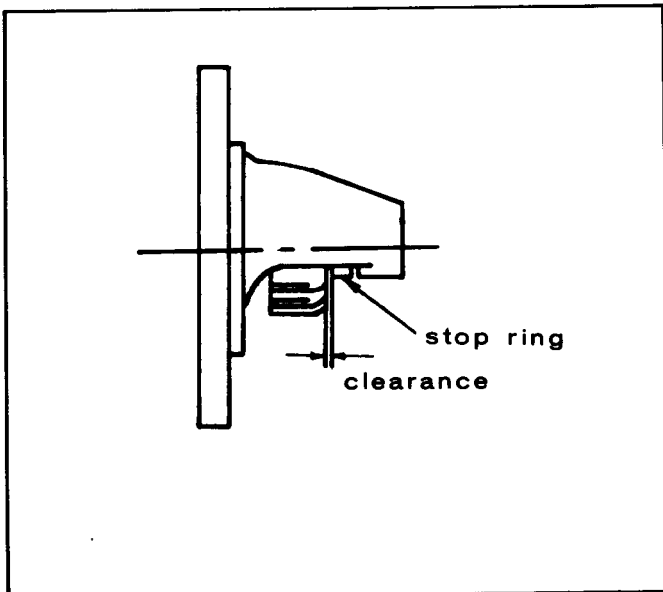


FIGURE 47. PINION CLEARANCE

1. Connect a battery of the proper voltage between the "Switch" terminal of the solenoid and the bracket of the starter (ground), so the pinion will travel.
2. Then, push the pinion back until play is taken out of the lever and the clutch mechanism.
3. Measure the pinion clearance.
4. The clearance should be 0.02 to 0.08 inch. Adjust by removing the solenoid and increasing or decreasing the number of the fiber washers used on the mounting surface of the solenoid.

Increasing the number of the washers decreases clearance, and decreasing the number of the washers increases clearance.

For the no load test, connect the starter as shown in Figure 48. The value of the meters should be as follows:

Battery Voltage	10.5V
Minimum R.P.M.	5000 r.p.m.
Maximum Current Draw.....	53A

CAUTION 1. Before installing the starter, be sure starter and engine mounting surfaces are free of dirt and oil. These surfaces must be clean to make good electrical contact.

2. Don't operate the starter more than 30 seconds, or serious damage may result. Starters are not designed for continuous operation.

3. When the engine does not rotate, don't hold the starter in a stalled condition more than 10 seconds.

4. The wires between the battery and the starter should be of sufficient size to carry the electric load without excessive voltage drop.

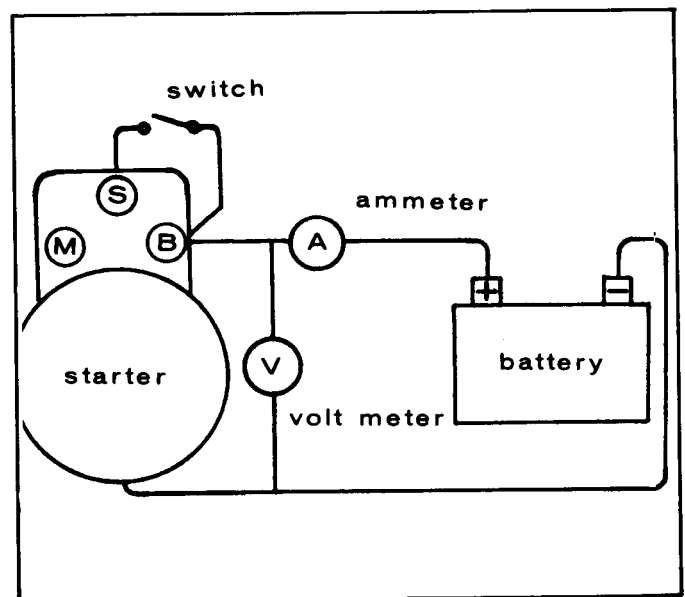


FIGURE 48. NO LOAD TEST

AC GENERATOR MAINTENANCE

GENERAL

The generator uses a revolving armature and normally needs little care other than a periodic check of the brushes and collector rings. If a major generator repair becomes necessary, have the equipment checked and tested by a qualified electrician who is thoroughly familiar with the operation of electric generating equipment.

All accessories must be taken off and power plant must be removed from its slide rails for disassembly and repair of the generator.

BRUSH REMOVAL AND REPLACEMENT

To gain access to brushes, remove plastic end bell screens. Measure brush wear as shown in Figure 49, using a small, narrow scale inserted into top of brush block. If brushes need replacing remove and tag wires connecting to brush blocks. Then remove brush blocks and lift out of end bell. Pull out the brushes and

springs from bottom of brush block. Clean out any dirt or oil from brush block at this time.

New brushes are shaped to fit and seldom need sanding to seat properly. Always replace brushes as a set and use only the correct brushes as listed in the *PARTS CATALOG*. Never use a substitute brush which may appear to be the same but may have entirely different electrical characteristics.

Note that brush blocks are stamped "BRG END" on one side. Be sure this stamped side faces bearing end of generator for correct brush alignment. Tighten the brush block screws to 40-70 in-lb. (4-6 ft-lb.). If some sparking occurs after replacing brushes, run the plant with a light load until brushes seat properly. Check brush springs for freedom of movement.

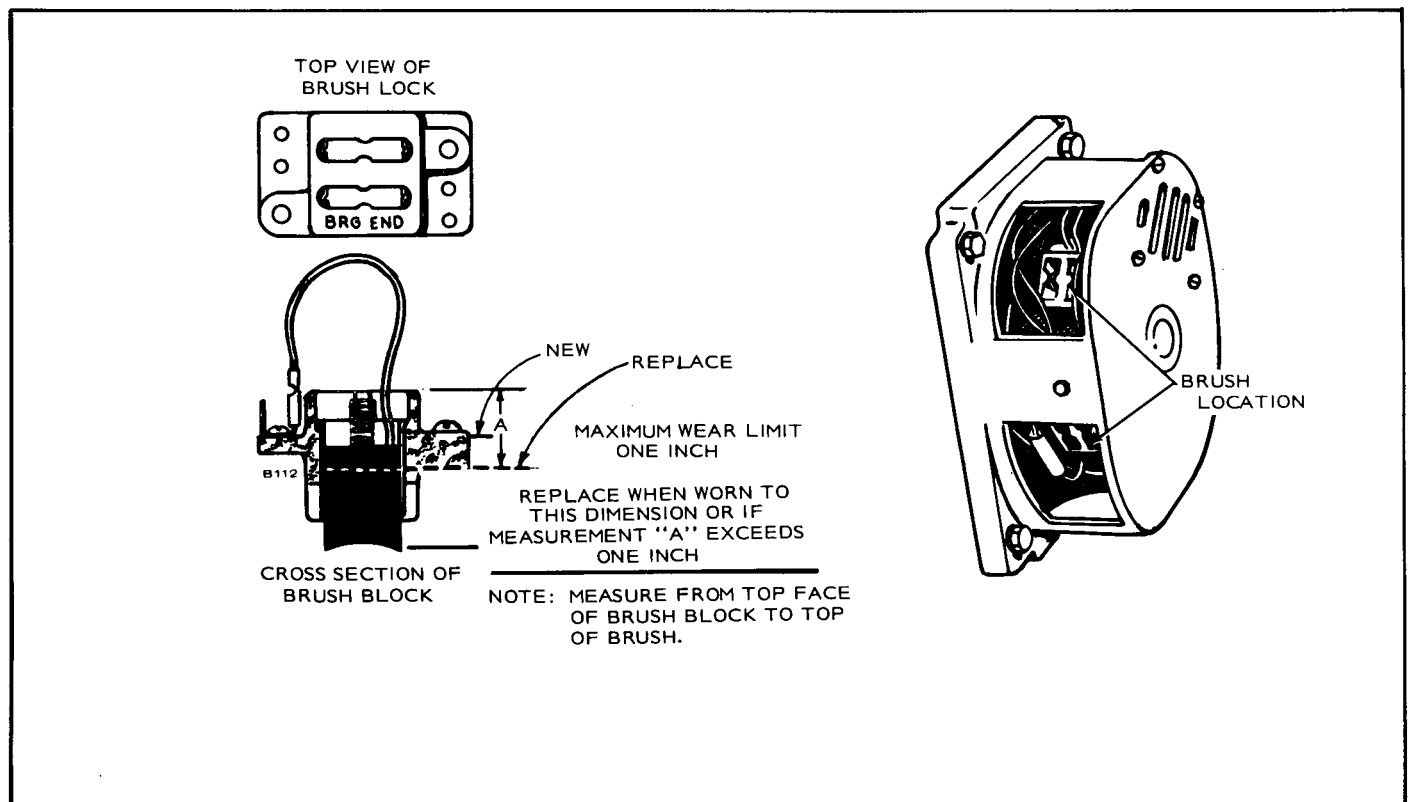


FIGURE 49. BRUSH WEAR LIMITS

GENERATOR DISASSEMBLY

1. Remove power plant from its slide rails.
2. Remove all accessories attached to the generator.
3. Tag and remove all leads.
4. Loosen and lift out both brush rigs.
5. Remove four generator through-stud nuts.
6. Lift or pull end bell from frame assembly. Do not pry loose with a screwdriver, use a plastic hammer and tap around edges of end bell to loosen.
7. Remove frame (field) assembly, being careful not to let it rest or drag on the armature.

CAUTION

Four seals are used between frame (field) assembly and engine-to-generator adapter.

These seals must be used when reassembling generator or the generator will overheat.

CAUTION

Do not strike the collector rings or bearing.

8. Using a square 3/8 inch drive, insert into 12-point (internal wrenching) armature hold-down nut and remove.
9. While pulling outward with one hand under the armature, strike a sharp end-wise blow on armature shaft to loosen armature. The armature has an internal taper which fits onto the external taper of engine adapter. If the armature does not come loose, place a heavy brass rod on the armature shaft near the ball bearing and strike a sharp downward blow on the rod with a hammer. Rotate the armature 1/2 turn before repeating.

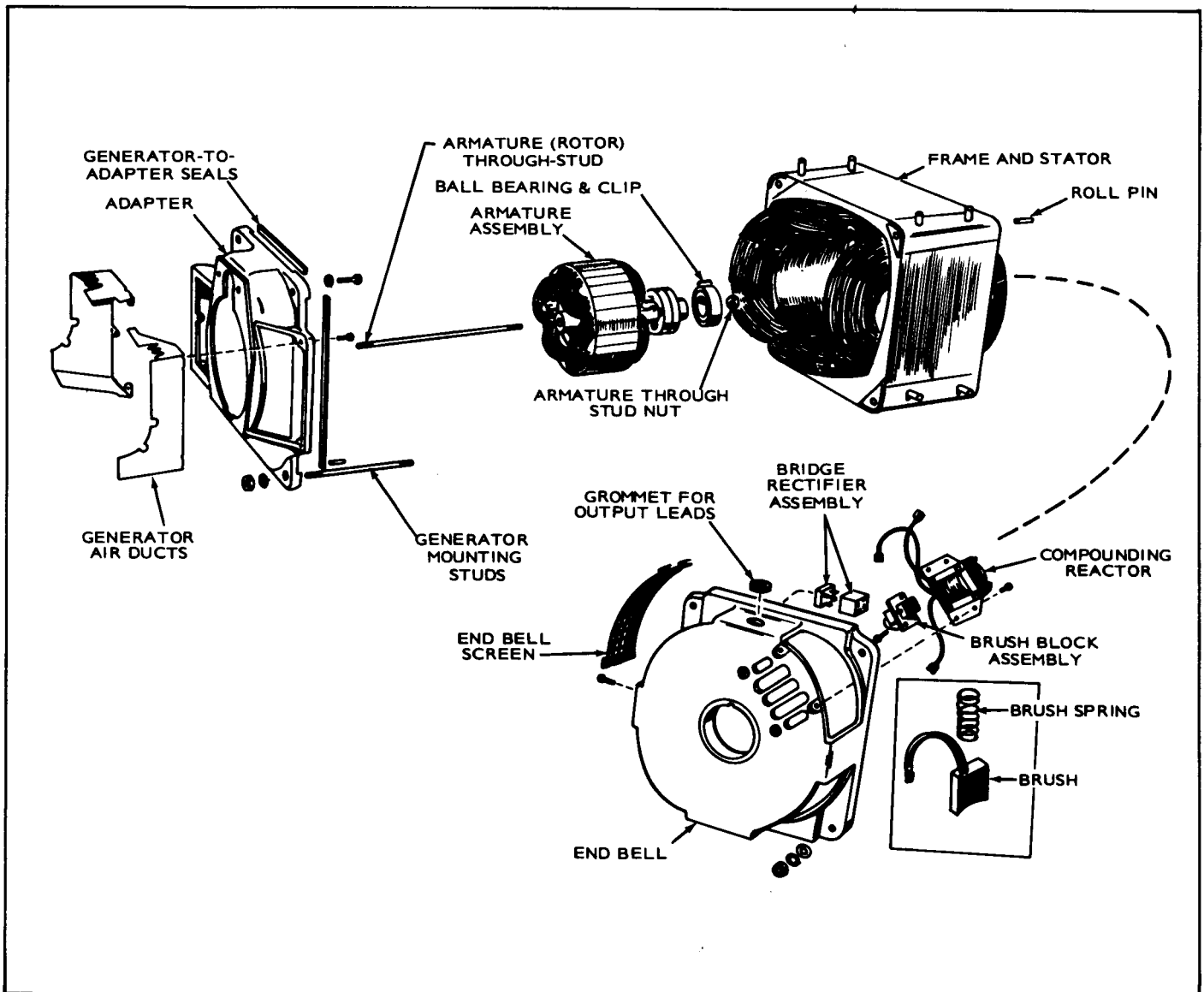


FIGURE 50. EXPLODED VIEW OF AC GENERATOR

ARMATURE GROUND TEST

Use a 120 volt series test lamp set for this test. Armature must be removed from generator for this test.

Place one test prod on one of the collector rings and the other test prod on the armature shaft. Test lamp should not light. If the test lamp lights, the AC winding or a collector ring is grounded to the shaft. Test both collector rings in this manner.

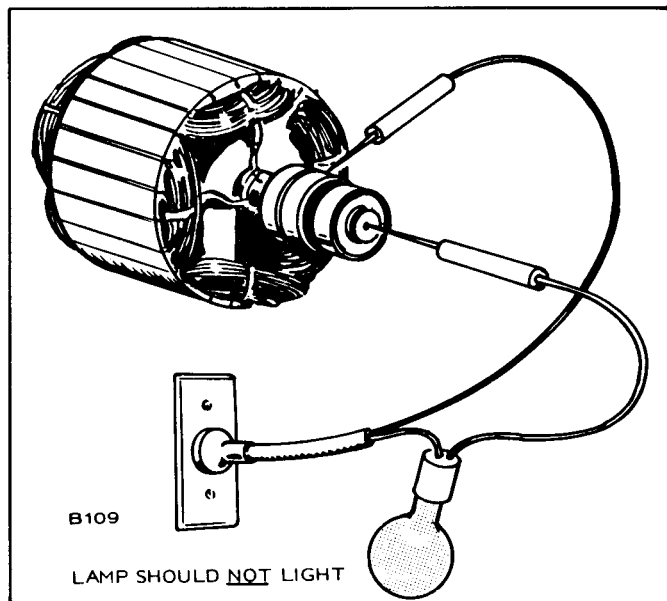


FIGURE 51. ARMATURE GROUND TEST

ARMATURE OPEN TEST

Use a 120 volt series test lamp set for this test. Place one prod on each collector ring. The test lamp should light. If lamp does not light, armature is open and must be replaced.

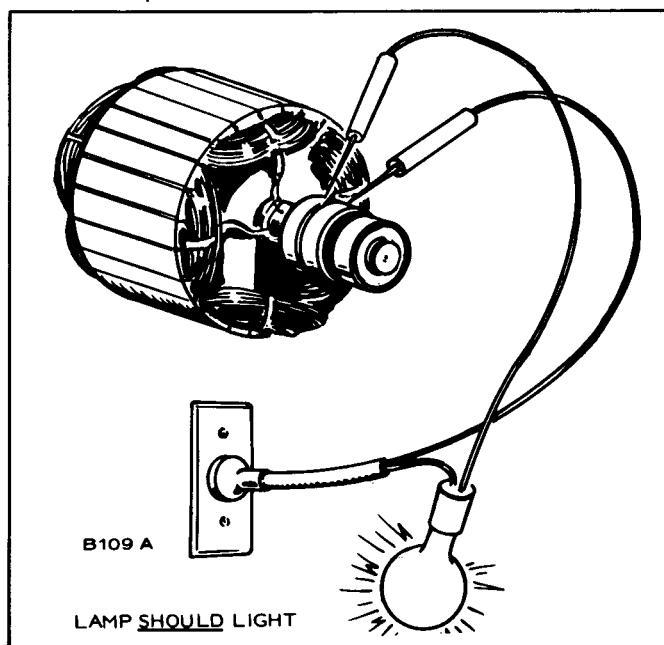


FIGURE 52. ARMATURE OPEN TEST

TESTING FIELD WINDINGS FOR GROUNDS

To test the field assembly for grounds, disconnect all field leads and use a 120 volt series test lamp set. Touch one prod to F1 (+) and the other prod to the frame. Lamp should not light. If lamp lights, field is grounded and must be replaced. (Test F2 lead in the same manner.)

TESTING FIELD WINDINGS FOR AN OPEN CIRCUIT

For this test use either an ohmmeter or a 120 volt series test lamp set.

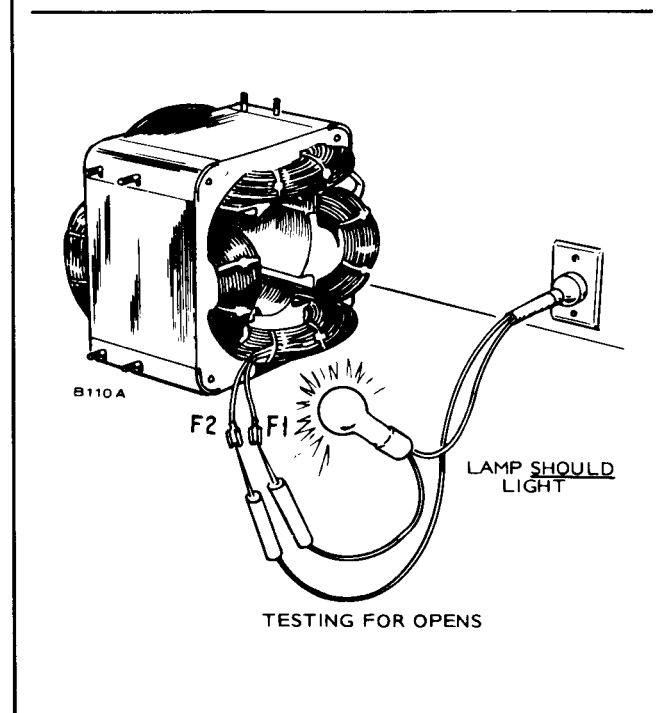
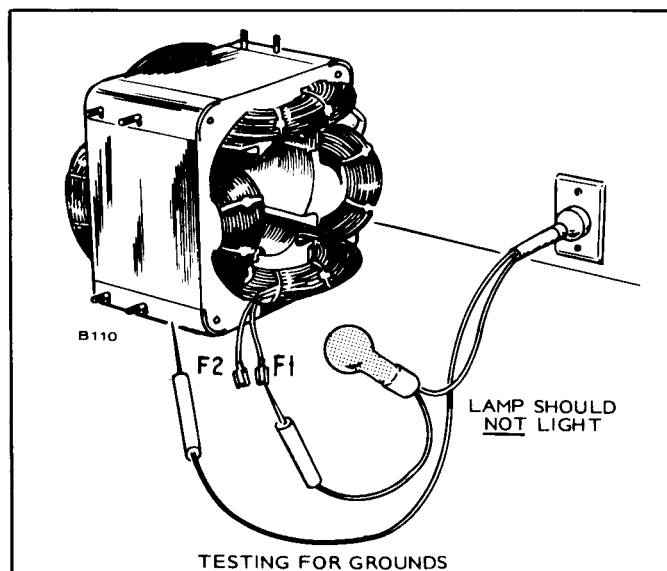


FIGURE 53. TESTING FIELD WINDINGS

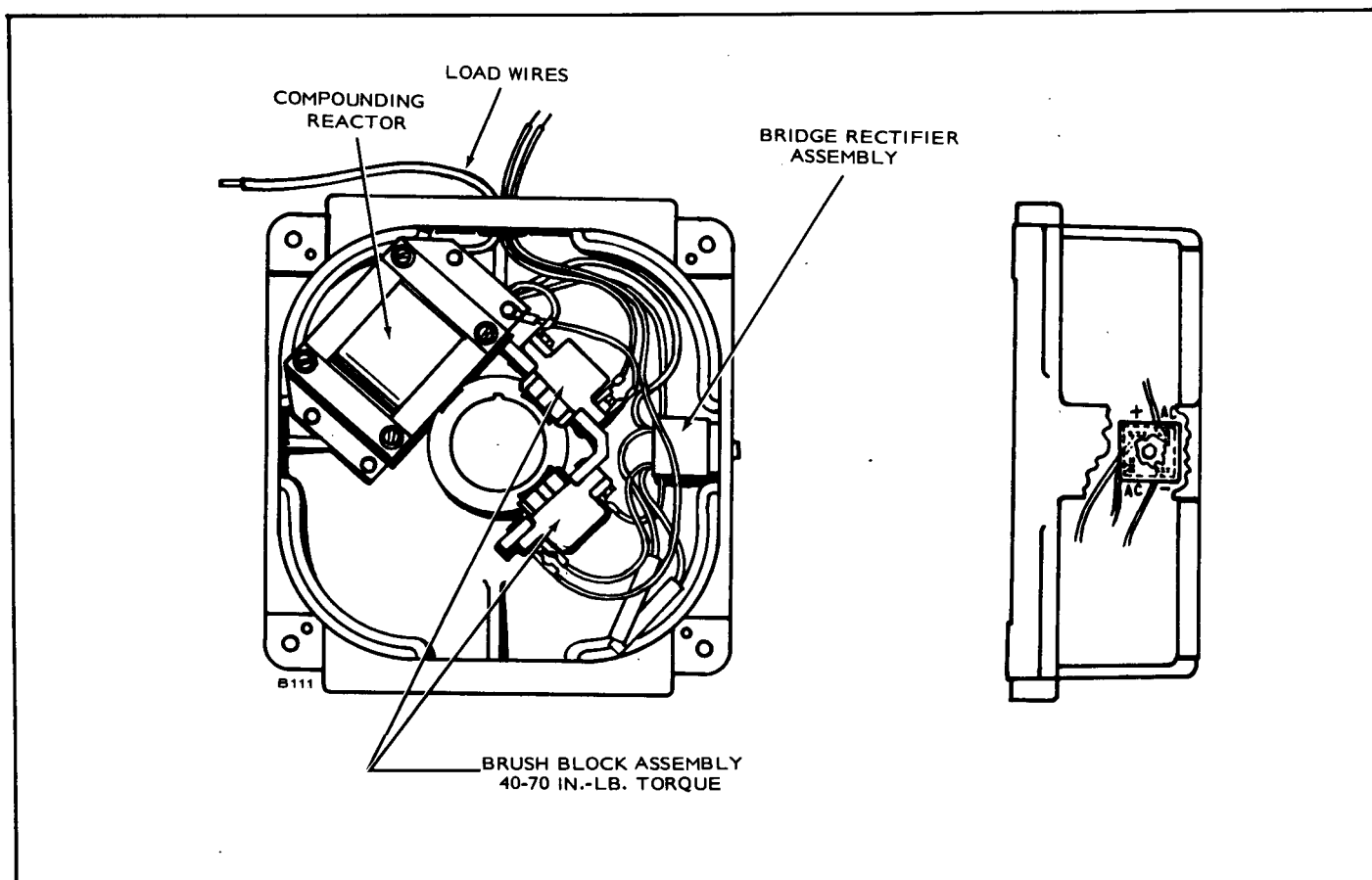


FIGURE 54. END BELL ASSEMBLY

Using an Ohmmeter: Disconnect external leads and connect ohmmeter leads to F1 (+) and F2 (-). Resistance in the windings should read 38 ohms ($\pm 3\%$) at 70 F.

Using a Test Lamp Set: Disconnect external leads and touch test prods to F1 and F2. The lamp should light. If not, field winding is open and must be replaced.

Check terminal ends closely for loose connections. These can be fixed easily without replacing the whole assembly.

TESTING BRIDGE RECTIFIER

To accurately test bridge rectifier proceed as follows:

1. Loosen No. 8-32 screw to remove bridge rectifier assembly (see Figure 54 for location).
2. Disconnect the nylon connector from bridge rectifier assembly, noting the polarity marking of bridge rectifier assembly and connector.
3. Pull out from end bell and remove bridge rectifier from its case.

CAUTION Note that connector can only be mounted in the end bell one direction, but the bridge rectifier can be mounted in (4) four directions of which only one will work.

4. Use an ohmmeter to test bridge rectifier. Set the ohmmeter dial to R x 1 scale.
5. Now place meter leads on points shown in Figure 55 and note readings from Table below.
6. If any tests do not agree with the above readings, install a new bridge rectifier.

CAUTION All terminals are marked on both bridge rectifier and nylon case. Observe proper polarity when reinstalling. If installed wrong, generator voltage will not build up.

OHMMETER BLACK LEAD *	OHMMETER RED LEAD *	RESISTANCE
A	B	* 8 ohms
A	D	* 8 ohms
B	C	* 8 ohms
D	C	* 8 ohms
B	A	Infinity
D	A	Infinity
C	B	Infinity
C	D	Infinity

* - 10% - Readings taken at 70 F.

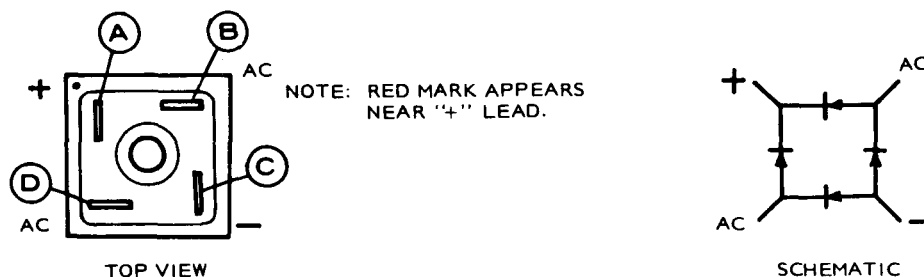


FIGURE 55. TESTING BRIDGE RECTIFIER

COLLECTOR RINGS

Collector rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly machined appearing surface. Ordinary cleaning with a dry, lint-free cloth is usually sufficient. Very fine sandpaper (#240 or finer) may be used to remove slight roughness. Use only light pressure on the sandpaper, while the plant is running. Do not use emery or carborundum paper or cloth. Clean out all carbon dust from the generator.

GENERATOR BEARING

The generator is prelubricated and double-sealed. Replace bearing approximately every 5 years or at each engine overhaul.

COMPOUNDING REACTOR

If output voltage is high with no electrical load connected to the generator, with generator running at 1800 rpm, then the compounding reactor is probably defective. Test as shown in Figure 56, using a variac.

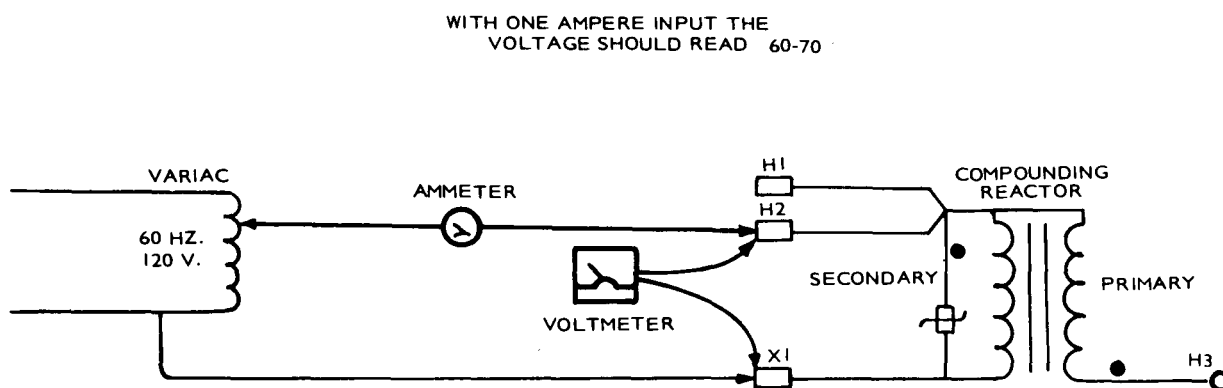


FIGURE 56. TESTING COMPOUNDING REACTOR

GENERATOR TROUBLESHOOTING GUIDE

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
NO AC OUTPUT VOLTAGE	1. Blown fuse or circuit breaker.	1. Replace fuse or reset breaker and look for cause.
	2. Disconnected wire or lead on brushes, bridge rectifier or reactor assembly.	2. Reconnect wire or wires.
	3. Brushes not making contact with collector rings.	3. Check brush springs for free movement or brushes which may be excessively worn.
	4. Open, grounded or short circuit in field or armature winding.	4. Test with series test lamp and repair or replace as necessary.
	5. Defective bridge rectifier assembly.	5. Test with ohmmeter and replace if defective.
	6. Bridge rectifier assembly installed wrong in its case.	6. Reinstall making sure marks on case and rectifier match.
LIGHTS FLICKER INTERMITTENTLY	1. Loose or broken lead/ leads in generator.	1. Repair broken lead or reconnect loose lead.
	2. Brushes stuck in holder.	2. Loosen brush and clean or turn rings in lathe.
LOW AC OUTPUT VOLTAGE	1. External short circuit on line.	1. Locate and eliminate short circuit problem.
	2. Generator overloaded.	2. Remove part of load.
	3. Shorted or grounded circuit in field or armature winding.	3. Test with series test lamp or ohmmeter and replace if defective.
	4. Engine not running properly causing generator to slow down.	4. Refer to Engine Troubleshooting guide.

GENERATOR TROUBLESHOOTING GUIDE (Continued)

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
NOISY GENERATOR	1. Defective bearing in end ball.	1. Replace bearing.
GENERATOR OVERHEATS	1. Generator overloaded.	1. Remove part of load.
	2. Windings and parts covered with oil or dirt.	2. Clean generator.
	3. Air intake restricted or incoming air too hot.	3. Take necessary steps to allow for proper cooling.
	4. Shorted or grounded circuit in armature or field windings.	4. Test with ohmmeter or series test lamp and replace if defective.
	5. Air seals are damaged or missing.	5. Replace air seals or tape over the air leak.
AC OUTPUT VOLTAGE HIGH WITH NO LOAD CONNECTED AND GENERATOR RUNNING AT 1800 RPM	1. Compounding reactor defective.	1. Remove, test and replace.

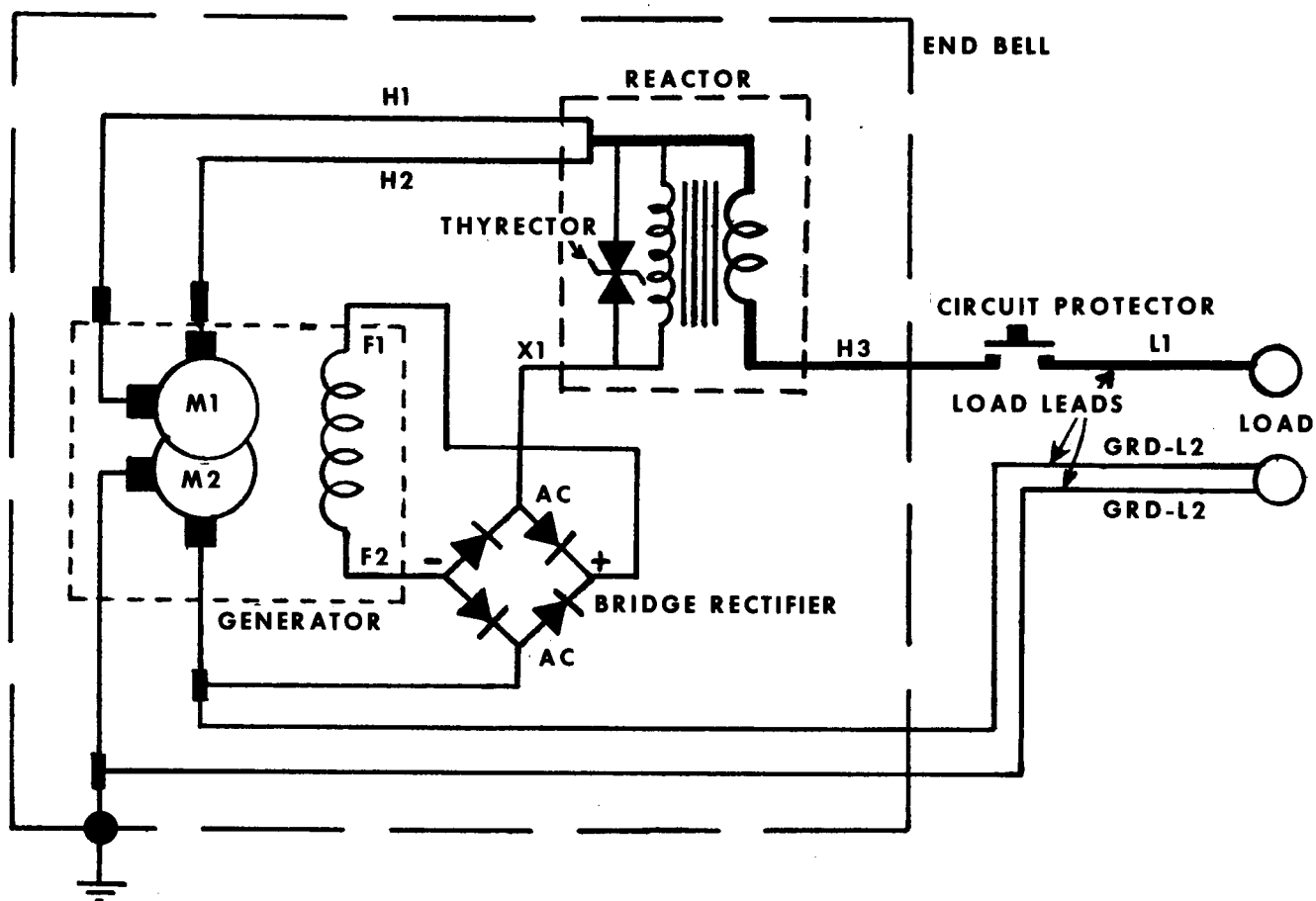


FIGURE 57. AC GENERATOR SCHEMATIC

GENERATOR VALUES FOR 6KW

MODEL	TYPICAL N.L. VOLTS	TYPICAL F.L. VOLTS	N.L. VOLTS X1 to H1	N.L. VOLTS F1 to F2	RESISTANCE F1 to F2	RESISTANCE H1 to X1	CURRENT FULL LOAD
6KW	123	113	80 VAC	50V DC	38 Ohms	0.85 Ohms	50 Amps

* N.L. — No Load
F.L. — Full Load

GENERATOR TORQUE VALUES

DESCRIPTION	TORQUE VALUE
Generator Through Studs (4).....	15-18 Ft.-Lb.
Armature Holddown Nut - 12 Point	45-50 Ft.-Lb.
Compounding Reactor Studs.....	4- 6 Ft.-Lb.
Brush Block Assembly Studs.....	4- 6 Ft.-Lb.

CONTROLS

THEORY OF OPERATION

Starting

To start, push start switch S3. Battery current flows through K1 solenoid, K2 contacts and start switch S3 to battery negative (GND). K1 solenoid closes contacts, feeding current to starter motor and to choke E1 plus K3 relay. K3 relay contacts close the circuit to the ignition coil T1 and fuel pump E2 plus fuel solenoid K4. The engine cranks and the fuel pump, fuel solenoid and ignition operate to start the engine.

Engine Starts

When the engine starts and rpm increases, the flywheel alternator develops a voltage which is rectified and energizes relay K2. Relay K2 contacts close to hold relay K3 energized, and K2 normally closed contacts open to drop K1 start solenoid. K3 contacts maintain current to ignition coil, fuel pump and fuel solenoid. The engine runs and K2 remains energized.

Stop Engine

Relay K3, energized by K2, maintains ignition. To stop engine, push the stop switch which shorts out K3. Relay K3 drops out to remove power from the fuel pump, fuel solenoid and ignition coil. Resistor R2 absorbs the power that was supplied to K3 during the period the stop switch is held closed as the engine slows to a stop.

Low Oil Pressure Shutdown

The control has a time delay of 2 to 4 seconds for a low oil pressure shutdown. If a low oil pressure condition occurs, the low oil pressure switch S2 closes to charge capacitor C3 through resistor R3. When the voltage on capacitor C3 matches the voltage of the divider R5-R6, the programmable unijunction transistor Q1 "fires" to trigger CR8. CR8 turns on to de-energize K3 relay. K2 contacts open as the engine stops and CR8 turns off.

EMERGENCY START-STOP OPERATION

In an emergency, the control board can be bypassed to start or stop the unit. Connect a jumper between terminals 9 and 11 to energize the ignition, fuel solenoid and fuel pump. Then temporarily jumper terminals 1 and 7 to energize starter. Remove this jumper as soon as the engine starts and runs. DO NOT jumper while engine is running. To stop, remove the jumper from terminals 9 and 11.



This emergency operation **DOES NOT** provide fuse protection, start disconnect or low oil pressure shutdown and should not be used without monitoring the electric power plant.

FUSE PROTECTION

A 5 amp fuse, installed on control board, protects the board from shorts in the remote wiring. If fuse is blown it can be replaced (after correcting trouble) by removing cover on control and replacing with an identical 5 ampere fuse.

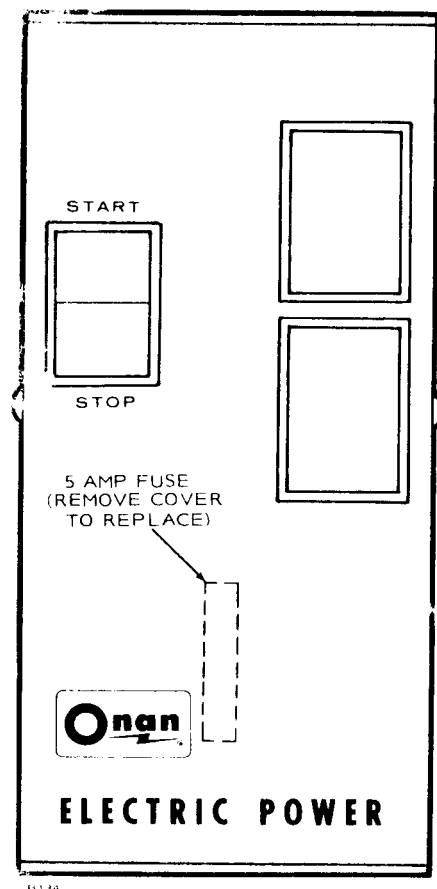
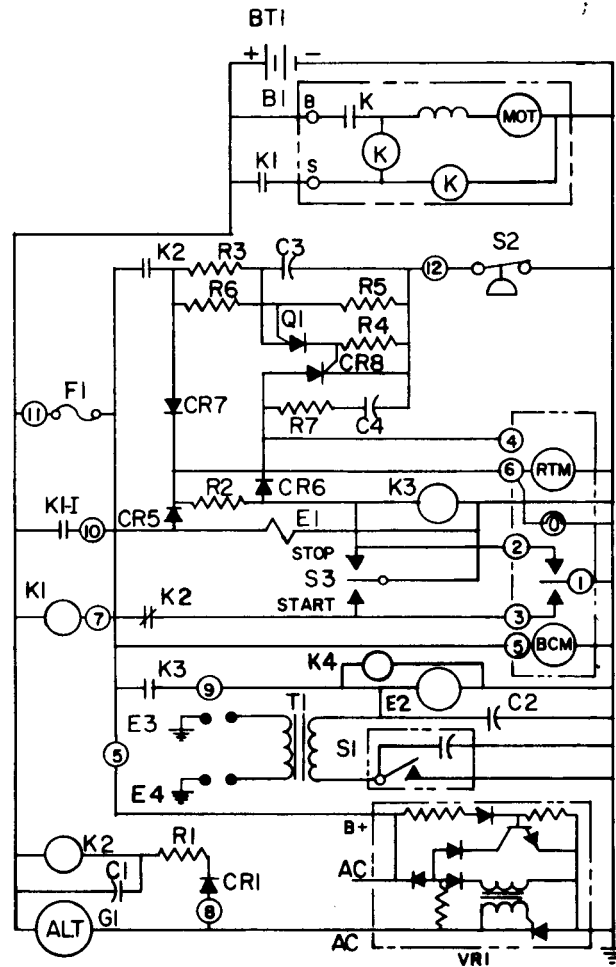


FIGURE 58. FUSE LOCATION

SCHEMATIC



BT1..... Battery
 B1 Starter
 E1 Electric Choke
 E2 Fuel Pump
 E3, E4 Spark Plugs
 F1 5 amp. Fuse
 G1 Alternator
 K1 Start Solenoid

S1 Breaker Box
 S2 Low Oil Pressure Switch
 S3 Start-Stop Switch
 T1 Ignition Coil
 VR1 Voltage Regulator
 RTM Running Time Meter (Opt.)
 BCM . Battery Condition Meter (Opt.)
 K4 Fuel Solenoid

FIGURE 59. CONTROL SYSTEM SCHEMATIC

CONTROL SYSTEM TROUBLESHOOTING GUIDE

This troubleshooting section is divided into four parts, A, B, C and D as follows:

- A. Engine does not crank.
- B. Engine cranks but does not start.
- C. Engine runs for 3 or 4 seconds, then stops.
- D. Low battery — low charge rate.

Always stop the power plant and disconnect the battery leads before removing the cover or printed circuit board. After removing control cover, use a long nose pliers to remove flag connectors from terminals on board. Pull flag connectors straight out to avoid breaking control board terminals. Although dust covers on two relays (K2 and K3) are removable, DO NOT attempt to adjust the contacts on these relays; they are precision set at the factory. The only maintenance required on these relays is blowing out sand and dirt with a low pressure, compressed air source.

To correct a problem, answer the question of the step either YES or NO. Then refer to the number in whichever column question was answered, and proceed to that step next.

A. ENGINE DOES NOT CRANK		YES	NO
1A.	Check battery. Are battery terminals clean and are cables tight?	2A	---
2A.	Check battery cables for correct polarity. Is 12 volts present across battery terminals with engine stopped and is 8 volts or higher present with engine cranking?	3A	10A
3A.	Remove cover on printed circuit board. Jumper terminal 7 to 3. Press start switch. Does engine crank?	4A	5A
4A.	K2 contact is defective. Replace printed circuit board.	---	---
5A.	Jumper terminal 7 to 1. Does engine crank?	6A	7A
6A.	Start switch S3 is defective. Replace printed circuit board.	---	---
7A.	Jumper from S terminal of B1 starter motor to positive (+). Does engine crank?	8A	9A
8A.	Replace K1 start solenoid.	---	---
9A.	Starter is defective. Remove and perform tests listed in STARTING SYSTEM section and/or replace starter.	---	---
10A.	Replace battery.	---	---

B.	ENGINE CRANKS BUT DOES NOT START	YES	NO
1B.	Is F1 fuse on control board OK?	3B	2B
2B.	Replace with an identical 5 amp fuse. Correct problem which caused fuse to burn.	---	---
3B.	While engine cranks, check K1-I start solenoid voltage. Is 12 volts present between terminals 10 and 1?	5B	4B
4B.	Replace K1 start solenoid.	---	---
5B.	Jumper terminals 9 to 11. Does engine start when start switch is pushed?	6B	7B
6B.	K2 contacts are defective. Replace printed circuit board.	---	---
7B.	Fuel solenoid K4 must be open during starting and running. Remove fuel line from carburetor. Does fuel pulsate from line when start switch is pushed? WARNING: Use extreme care for tests 7B and 8B. Direct the fuel flow into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.	11B	8B
8B.	Disconnect fuel solenoid from line and check fuel pump E2. Pump will click when operating properly. Does fuel pulsate from pump (solenoid disconnected) when start switch is pushed?	10B	9B
9B.	Fuel pump (or wiring) is defective and must be replaced.	---	---
10B.	Fuel solenoid is defective and must be replaced.	---	---
11B.	Is electric choke closed when engine is cranking?	13B	12B
12B.	Voltage at choke terminal when engine is cranking should be 12 volts. If choke does not move (at room temperature) with 12 volts applied, replace it. Also check wire from choke to control for shorts to ground.	---	---
13B.	The fault is in the ignition system. Check points, plugs, wires and coil. Refer to IGNITION section.	---	---

C.	ENGINE RUNS 3 OR 4 SECONDS - THEN STOPS	YES	NO
1C.	Check oil level. Refill to FULL mark on dipstick. Does engine now continue to run?	---	2C
2C.	Check voltage from terminal 11 to 12. Is it 12 volts with engine stopped and does voltage drop to zero when engine runs?	---	3C
3C.	Check oil pressure sensor wire for shorts to ground by visually tracing wire from S2 low oil pressure switch to control. Is wire grounded?	4C	5C
4C.	Replace or repair wire making sure it isn't rubbing against anything that may again cause a grounding problem.	---	---
5C.	Replace low oil pressure switch S2.	---	---
D.	LOW BATTERY - LOW CHARGE RATE	YES	NO
1D.	With engine cranking, measure voltage at terminal 8 to BAT terminal of K1 start solenoid. Is 6 volts present?	2D	3D
2D.	Check battery connections. They must be clean and tight.	---	---
3D.	Check flywheel alternator G1 output. Disconnect AC lead that connects to voltage regulator VR1 and connect voltmeter to this lead and BAT terminal of K1 start solenoid. This checks AC open circuit voltage. Start engine. Is AC output voltage approximately 28 volts with unit running at 1800 rpm?	5D	4D
4D.	Replace alternator stator G1.	---	---
5D.	Connect a voltmeter across battery terminals. Start engine. Does DC voltage increase to 13 to 14-1/2 volts after engine is running for a few minutes?	---	6D
6D.	Remove and replace voltage regulator VR1.	---	---

REMOTE ACCESSORIES

ONAN REMOTE SWITCH (300-0985)

This switch provides a remote start-stop option in addition to the plant mounted start-stop switch. A small amber lamp, located on center of switch, flows when the electric power plant is running. To install, proceed as follows:

1. Determine location of remote control and cut a hole in motor home panel to accommodate switch (Figure 60).
2. Wires provided for remote connections terminate within plant junction box. Connect four lengths of #18 multistrand wire to wires in junction box labeled 1, 2, 3 and 6. Connect to corresponding terminals on remote switch.

Use an approved connection method within junction box (e.g. wire nuts or connector block).

3. Route remote wires through a separate knockout plug on plant junction box.

Do not route these remote wires through the same conduit as AC load wires. Use a separate conduit (greenfield) for these wires.

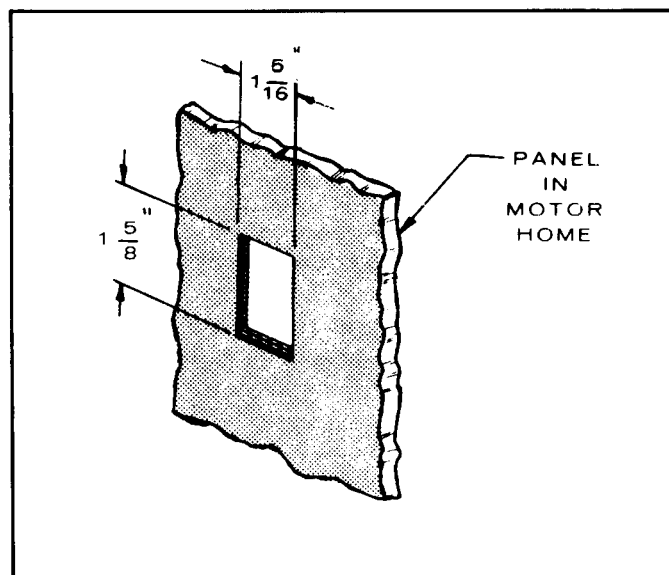


FIGURE 60. PANEL CUTOUT (300-0985)

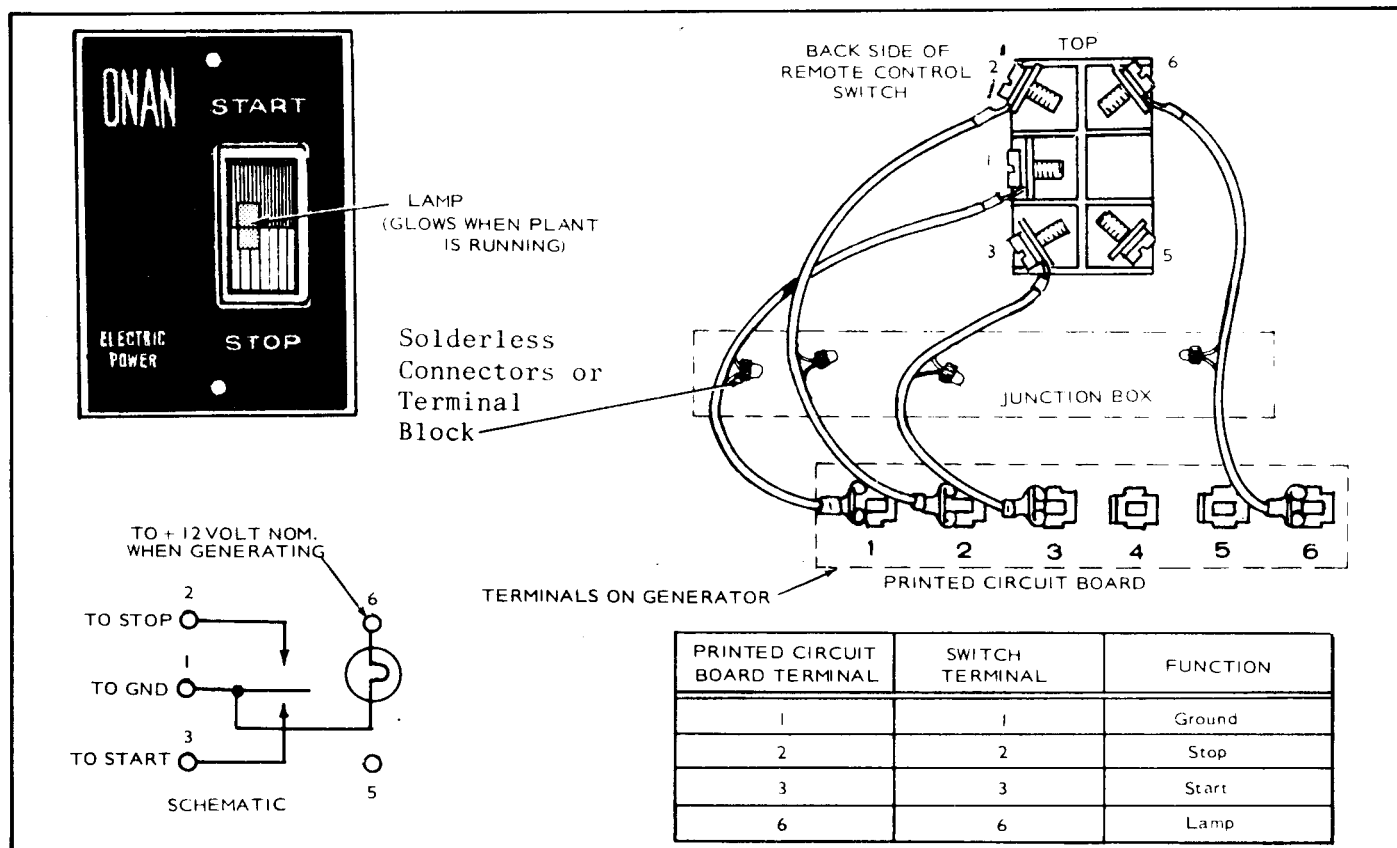


FIGURE 61. REMOTE CONTROL SWITCH (300-0985)

4. Make connections to remote switch (Figure 61), then secure remote switch to motor home panel with #5 wood screws.

WARNING Seal opening made between plant compartment and motor home interior to prevent deadly exhaust gases from entering motor home.

ONAN DELUXE REMOTE CONTROL (300-0986)

This switch provides a remote start-stop option in addition to the plant mounted start-stop switch. A small amber lamp, located on center of switch, glows when the electric power plant is running. A running time meter (time totalizer) shows the total number of plant operating hours. It is useful for performing accurate maintenance procedures on the plant. A battery condition meter monitors battery charge condition. Connection for control is as follows:

1. Determine location of remote control and cut a hole in motor home panel to accommodate control (Figure 62).
2. Wires provided for remote connections terminate within plant junction box. Connect five lengths of No. 18 wire to wires in junction box. These wires are labeled 1, 2, 3, 5 and 6; they must connect to corresponding terminals on remote control panel.

Use an approved connection method (e.g. wire nuts or connector block).

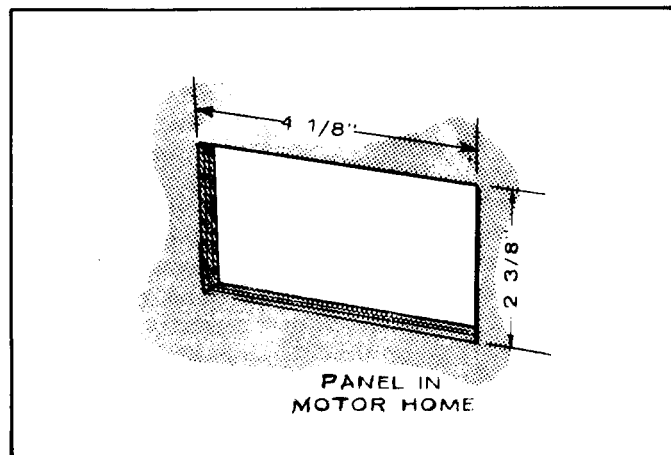


FIGURE 62. PANEL CUTOUT (300-0986)

3. Route remote wires through a separate knockout plug on junction box.

Do not route these remote wires through the same conduit as the AC load wires. Use a separate conduit (greenfield) for these wires.

4. Make connections to remote control panel (Figure 63), then secure remote control panel with #5 wood screws.

WARNING Seal any opening made between plant compartment and motor home interior to prevent deadly exhaust gases from entering the motor home.

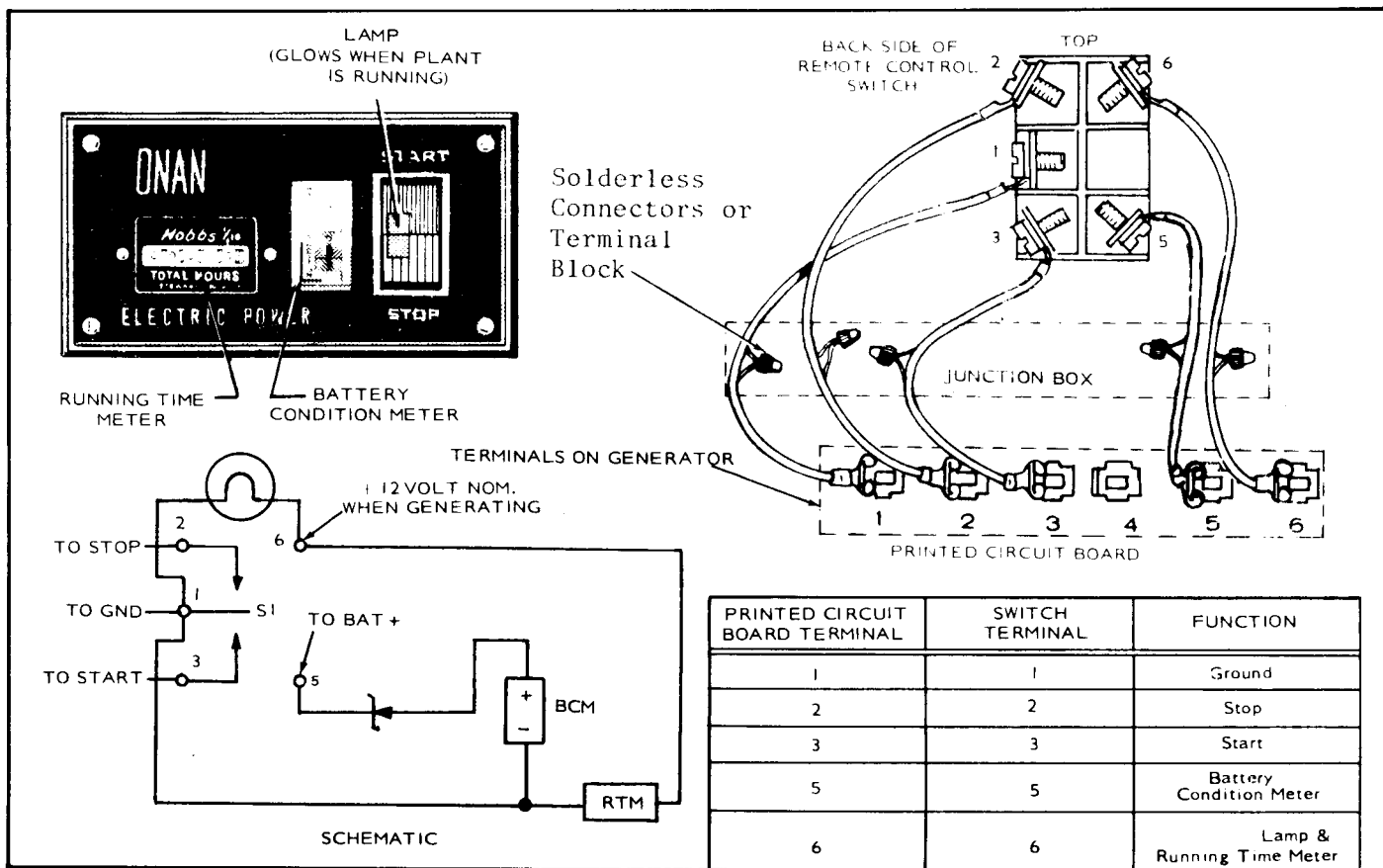


FIGURE 63. DELUXE REMOTE CONTROL (300-0986)

INSTRUMENT CONNECTIONS

The following instructions will help when installing individual switches and indicators.

Remote Start-Stop Switch: A remote start-stop switch can connect to terminals 1 and 3 for start and terminals 1 and 2 for stop. Use a single throw, double throw switch (momentary) rated at 5 amperes, such as Onan switch 308-0341. This switch can be remotely connected with up to 100 feet of number 18 wire.

Remote Voltmeter: A 0-15 volt DC voltmeter can connect to terminals 1 (-) and 5 (+) to measure battery voltage.

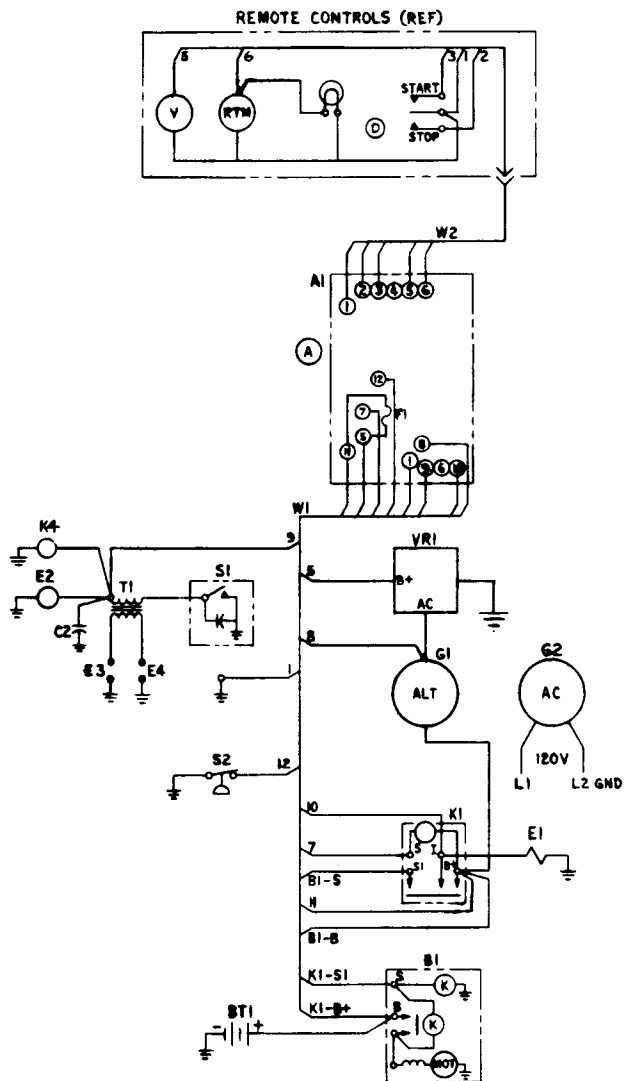
Running Time Meter: A running time meter, such as Onan 302-0885, can connect to terminals 1 (-) and 6 (+) to indicate the total running time of the electric power plant. These terminals are rated at 12 volts and a maximum load of 1 ampere.

Charge Ammeter: A DC ammeter (0-15 amperes) can connect to unit to read battery charging current. Disconnect alternator lead from K1 start solenoid and connect to positive side of ammeter. Connect negative lead to K1 start solenoid (battery terminal).

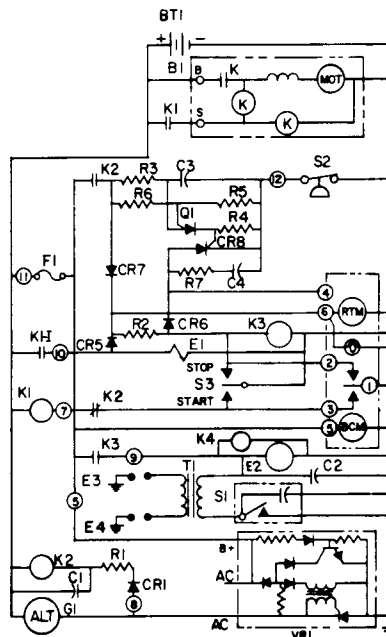
The charge current should be 9 amperes maximum at 1800 rpm (room temperature). The charge current tapers to less than 2 amperes as battery voltage increases to 14-15 volts.

611C1094

WIRING DIAGRAM



SCHEMATIC



NOTE:
1. MIN START DISCONNECT: 675 RPM.

REF. DES.	PART NO.	QTY	DESCRIPTION
	300CB45	1	CONTROL ASSY-GEN SET
A1		1	CONTROL-MOT HOME
B1		1	STARTER-SOLENOID SHIFT
BT1		1	BATTERY-12 VOLT
C2		1	CAPACITOR
E1		1	CHOKE
E2		1	FUEL PUMP
E3, 4		2	SPARK PLUG
G1		1	ALTERNATOR
G2		1	GENERATOR
K1		1	SOLENOID-START
S1		1	BREAKER & CAP ASSY
S2		1	SWITCH-LOW OIL PRESS
S3		1	SOLENOID-FUEL
T1		1	COIL-IGNITION
VR1		1	VOLTAGE REGULATOR
W1		1	WIRING HARNESS-GEN SET
W2		1	WIRING HARNESS-REMOTE

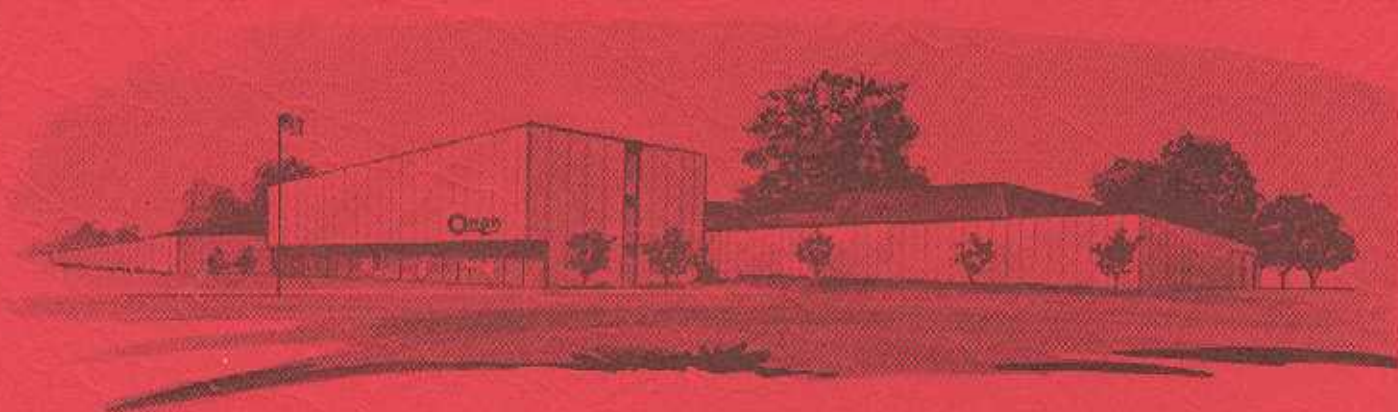
611C1094

C WAS K2	7-7-72
D REVISED CIRCUIT	7-7-72
C ADD FUEL SOLENOID	7-7-72
B NEW SCHEMATIC	7-7-72
A REVISED AT IN WD & SCHEM	7-7-72
A REVISED AT IN WD & SCHEM	7-7-72

REVISION: 7-7-72

7-7-72

MODEL NO.	7-7-72	CDR	HGM	WJB
NAME	CONTROL-GEN SET			
NAME	(WIRING DIAGRAM)			
DWG. NO.	611C1094			



ONAN 1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432

A DIVISION OF ONAN CORPORATION

